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A

NATURAL HISTORY,

GENERAL AND PARTICULAR;

CONTAINING THE

HISTORY AND THEORY OF THE EARTH,

A GENERAL HISTORY OF MAN,

THE BRUTE CREATION, VEGETABLES, MINERALS, &c. &c.

BY GEORGE LOUIS LE CLERC, COUNT OF BUFFON.

TRANSLATED FROM THE FRENCH

BY WILLIAM SMELLIE,

MEMBER OF THE ANTIQUARIAN AND ROYAL SOCIETIES OF EDINBURGH.

A NEW EDITION CORRECTED AND ENLARGED.

TO WHICH IS ADDED

A HISTORY

OF

BIRDS, FISHES, REPTILES, AND INSECTS,

EMBRACING THE

RECENT DISCOVERIES OF EMINENT NATURALISTS;

TOGETHER WITH AN

ACCOUNT OF THE MOST CURIOUS FOREIGN PLANTS.

BY HENRY AUGUSTUS CHAMBERS, LL. D.

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THE

NATURAL HISTORY OF ANIMALS

CONTINUED.

THE GLUTTON.

THE glutton, with his gross body and short legs, is nearly of the figure of the badger; but he is double the size. His head is short, his eyes small, his teeth very strong, his body squat, and his tail rather short than long, and well furnished with hair at the extremity. He is black on the back, and of a brownish red on the flanks. His fur is exceedingly beautiful, and in great request. He is common in Lapland, and in all the countries bordering on the northern ocean, both in Europe and Asia. In Canada, and other parts of North America, he is found under the name of *carcajou.* It is probable, that the animal found near Hudson's Bay, called *quick-hatch,* or *wolverene,* by Mr. Edwards, is the same with the Canadian carcajou, and the European glutton. It is also probable, that the animal mentioned by Fernandez, under the name of *tepeytzcuitli,* or *mountain dog,* is the glutton, whose species has been diffused as far as the desert mountains of New Spain.

Olaus Magnus seems to be the first author who takes notice of this animal. He says, that it is of the size of a large dog; that it has the ears and face of a cat, strong feet and claws, long, brown, bushy hair, and a rough tail like that of the fox, but shorter. The glutton, according to Schoeffer, has a round head, strong sharp teeth, like those of the wolf, black hair, and a thick body and short legs, like those of the otter. La Hontan, who first mentioned the carcajou of North America, remarks, 'Figure to yourself a double-sized badger, 'which is the most perfect idea I can give you of this 'animal.' According to Sarazen, who probably had seen only young ones, the carcajous exceed not two feet in length, and their tail is eight inches. 'They have,' says he, 'a very thick, short head, small eyes, and very 'strong jaws, furnished with thirty-two sharp teeth.' The quick-hatch of Edwards, which appears to be the same animal, was, this author remarks, double the size of a fox: its back is arched, its head low, its legs short, its belly almost trailing on the ground, and its tail of a middling length, and bushy toward the extremity. All these authors agree, that this animal is only to be found in the northern regions of Europe, Asia, and America. M. Gmelin is the only writer who seems to think that the glutton travels into warm countries.

[The glutton is the only animal, which, like man, can live equally under the line and under the pole. He is every where to be seen: he runs from south to north, and from north to south, provided he can find any thing to eat.—*Gmelin.*]

But this fact appears to be very suspicious, if not altogether false. Gmelin, like some other naturalists, has perhaps confounded the hyæna of the south with the glutton of the north, which, though they resemble each other in natural dispositions, and particularly in voraciousness, are very different animals.

The legs of the glutton are not made for running; he even walks slow. But this defect of nimbleness he supplies with cunning. He lies in wait for animals as they pass. He climbs upon trees, in order to dart upon his prey, and seize it with advantage. He throws himself down upon elks and rain deer, and fixes so firmly on their bodies with his claws and teeth, that nothing can remove him. In vain do the poor victims fly, and rub themselves against trees. The enemy, attached to their crupper or neck, continues to suck their blood, to enlarge the wound, and to devour them gradually, and with equal voracity, till they fall down. It is inconceivable how long the glutton can eat, and how much flesh he can devour at a meal.

[The glutton is a carnivorous animal, somewhat less than the wolf. His hair is coarse, long, and of a brown colour, approaching to black, especially on the back. He climbs upon a tree to watch for his prey; and, when any animal passes, he springs down upon its back, fixes himself firmly with his claws, and continues to gnaw with his teeth, till the poor animal, after many fruitless efforts to get rid of so troublesome a guest, at last falls down, and becomes a victim to his crafty enemy. Three strong greyhounds are necessary to kill the glutton.

The Russians use the glutton's skin for muffs, and borders to their caps.—*Relation de la Grande Tartarie.*]

What is related by travellers, concerning this animal, is perhaps exaggerated. But, though a great part of their narrations were rejected, what remains is sufficient to convince us, that the glutton is much more voracious than any of our carnivorous animals: from this circumstance he has been called the *vulture af quadrupeds.* More insatiable and rapacious than the wolf, if endowed with equal agility, the glutton would destroy all the other animals. But he moves so heavily, that the only animal he is able to overtake in the course is the beaver, whose cabins he sometimes attacks, and devours the whole, unless they quickly take to the water; for the beaver outstrips him in swimming. When he perceives that his prey has escaped, he seizes the fishes; and, when he can find no living creature to destroy, he goes in quest of the dead, whom he digs up from their graves, and devours with avidity.

[The carcajou is a small animal, but very strong and fierce. Though carnivorous, he is so slow and heavy, that he may be said rather to trail upon the snow, than to walk. The beaver is the only animal he is able to overtake; and this exploit he can perform in summer only, when the beavers are out of their cabins: but, in winter, he endeavours to demolish their cabins, and seize the inhabitants, which he is seldom able to accomplish; because the beavers secure their retreat under the ice.—*Hist. de. l'Acad. des Sciences, ann.* 1713.]

Though the glutton employs considerable art and address in seizing other animals, he seems to possess no other talents but those which relate to appetite. It would appear that he even wants the common instinct of self-preservation. He allows himself to be approached by men, or comes up to them, without betraying the smallest apprehension. This indifference, which seems to be the effect of imbecility, proceeds perhaps from a different cause. It is certain that the glutton is not stupid, since he finds means to satisfy his appetite, which is always vehement and pressing. Neither is he deficient in courage, since he indiscriminately attacks all animals he meets with, and betrays no symptoms of fear at the approach of man. Hence, if he wants attention to himself, it proceeds not from indifference to his own preservation, but from the habit of security. As he lives in a country which is almost desert, he seldom sees men, who are his only enemies. Every time he tries his strength with other animals, he finds himself their superior. He goes about with perfect confidence, and never discovers the smallest mark of fear, which always supposes some dolorous event, some experience of weakness. Of this we have an example in the lion, who never turns away from man, unless he has experienced the force of his arms: and the glutton, trailing along the snows of his desert climate, remains always in perfect safety, and reigns like the lion, not so much by his own strength, as by the weakness of the animals around him.

[The workmen perceived at a distance an animal approaching with slow and solemn steps. Some of them imagined it to be a bear, and others a glutton. They advanced, and found that it was a glutton. Having given it some severe blows with a cudgel, they seized it alive, and brought it to me. After the many reports I had for several years heard from the Siberian hunters concerning the address of the glutton in seizing other animals, and supplying by cunning that swiftness which nature has denied him, and in avoiding the snares of men, I was greatly surprised to see this one come as deliberately up to us as if he had been in quest of his own destruction. Ysbrandt-Ides calls the glutton a mischievous animal, which lives on flesh only. 'He is accustomed,' this author remarks, 'to conceal himself in the trees, and to 'lie in ambush, like the lynx, till a stag, a rain deer, a 'roebuck, a hare, &c. passes below, and then darts 'down, like an arrow, upon the animal, sinks his teeth 'into its body, and gnaws the flesh till it expires; after 'which he devours it at his ease, and swallows both the 'hair and the skin. A waywode, who kept a glutton for 'his pleasure, threw it one day into the water, and let 'loose two dogs at it. But the glutton soon fixed upon 'the head of one of the dogs, and kept it under water 'till the animal was suffocated.' The address employed by the glutton, continues M. Gmelin, in seizing animals is confirmed by all the hunters. Though he devours all kinds of animals, whether alive or dead, he prefers the rain deer. He watches large animals like a robber on the highways, or he surprises them while asleep. He goes in quest of the snares laid by the hunters for different species of animals; but he never allows himself to be entrapped. The hunters of the blue and white foxes, (isatis) which frequent the coasts of the frozen sea, complain much of the mischief done them by the glutton. With much propriety they call him the *glutton;* for the quantity he eats is incredible. Though I frequently inquired of professed hunters, I never heard that this animal when gorged squeezed himself between two close trees, in order to force out the contents of his stomach, and to make room for a fresh gratification of his insatiable appetite. This appears to have been the fable of a naturalist, or the fiction of a painter.—*Gmelin.*]

The isatis is not so strong, but much more nimble than the glutton, whom it serves as a provider. The glutton follows the isatis in the chase, and often carries off the whole, or a part of its prey; for when the glutton arrives, the isatis, to avoid its own destruction, flies off with precipitation. Both these animals dig holes in the earth; but their other manners are different. The isatis often go in packs: but the glutton travels alone, or sometimes with his female. The male and female are generally found together in the same hole. Even the most courageous dogs fear to approach, or to combat the glutton. He defends himself with his claws and feet, with which he inflicts mortal wounds. But as he cannot escape by flight, he is easily dispatched by the hunters.

The flesh of the glutton, like that of all rapacious animals, is very bad. He is hunted only for his skin, which makes a most magnificent fur. It is only excelled by the furs of the sable and black fox; and when well chosen and properly prepared, it is said to have a finer lustre than any other, and upon a beautiful black ground-colour to reflect and variegate the light, like damask silk.

[The gluttons are common in Lapland. The skin is extremely black, and the hair reflects a kind of shining whiteness, like the flowered sattins and damasks. Some people compare it to the skin of the sable, except that the hair of the latter is softer and more delicate. This animal lives both on the earth, and in the water, like the otters. But the glutton is much larger, and more voracious than the otter. He not only hunts wild and domestic animals, but even fishes.—*Schœffer.*]

SUPPLEMENT.

I am now enabled to give a figure of the glutton. This animal was sent to me alive from the most northern parts of Russia; and yet he lived more than eighteen months at Paris. He was so tame that he discovered no ferocity, and did not injure any person. His voracity has been as much exaggerated as his cruelty. He indeed eat a great deal; but when deprived of food he was not importunate. The animal is very well represented in the plate; but we shall likewise add a description of him. He is two feet two inches long from the point of the nose to the origin of the tail. The muzzle, and as far as the eyebrows, is black. The eyes are black and small. From the eye-brows to the ears the hair is a mixture of white and brown. The ears exceed not an inch in length, and the hair on them is short. Below the under jaw, as well as between the fore feet, the hair is spotted with white. The length of the fore legs is eleven inches, and that of the hind one foot. The tail, including four inches of hair at its extremity, is eight inches long. The four legs, the tail, the back, as well as the belly, are black. Near the navel is a white spot, and the organs of generation are reddish. The under hair, or down, is white: his fore feet, from the heel to the extremity of the claws, are three inches nine lines in length. The five claws are very crooked and well separated. The middle claw is an inch and a half long. There are five callosities under the toes; four of them form a kind of semicircle below the foot, the other is on the heel. On the hind feet there are five claws, nine callosities, and no heel. The breadth of the fore feet is two inches and a half. The length of the hind feet is four inches nine lines, and their breadth two inches nine lines. He has six cutting teeth in the upper jaw, of which one on each side is larger than the other four; and five grinders, two of which are much larger than the other three. In the under jaw he has five grinders, one of which is very thick. There are a few hairs, about two inches long, round the mouth, and above the eyes.

This animal is pretty mild. He avoids water, and dreads horses, and men dressed in black. He moves by a kind of leaps; and eats pretty voraciously. After taking a full meal he covers himself in his cage with straw. When drinking he laps like a dog. He utters no cry. After drinking, with his paws he throws the remainder of the water on his belly. He is almost perpetually in motion. If allowed he would devour more than four pounds of flesh every day. He eats no bread; and devours his food so voraciously, and almost without chewing, that he is apt to choke himself.

The glutton is common in most of the northern regions of Europe, and even of Asia; but in Norway, according to Pontoppidan, he is chiefly confined to the diocese of Drontheim. This author remarks, that the skin of the glutton is very valuable; that he is not shot with fire arms to prevent his skin from being damaged; and that the hair is soft, and of a black colour, shaded with brown and yellow.

We have likewise given the figure of an American animal, a stuffed skin of which was sent to M. Aubry, curate of St. Louis, under the denomination of *carcajou.* But it has no affinity to that animal, which we remarked was the same with our European glutton; for as its claws are not adapted for tearing prey, but for digging the earth, we consider it as a neighbouring species, or even as a variety of the badger. When compared with the figure we have given of the badger the resemblance is apparent; from which it differs, however, by having only four toes on the fore feet: but the fifth toe, which was apparently wanting, might have been destroyed in this dried skin. In this character it differs equally from the carcajou and the glutton; because both of them have five toes on the fore feet. Hence it is doubtful whether this animal be the true carcajou. We shall here add a description of the stuffed skin, which is very well preserved in the cabinet of M. Aubry. He was assured that it was brought from the country of the Eskimaux. From the end of the muzzle to the origin of the tail it was two feet two inches long. Though it has a great resemblance to the badger it differs from him in the colour and quality of the hair, which is softer, longer, and more silky; and by this character alone it approaches to the carcajou or the glutton of Europe. It is nearly of the colour of the lynx, being grayish white, with white stripes on the head, but different from those of the badger. The ears are short and white. It has thirty-two teeth, six incisors, two large canine teeth, and four grinders on each side; but the badger has only six grinders. The hairs on the body, which are commonly four and a half or five inches long, are of four colours, namely, from the root to near the middle they are a bright brown, then a bright yellow, then black till near the point, which is white. The under part of the body is covered with white hairs. On the legs the hair is of a deep brown colour. There are four toes only on the fore feet, and five on those behind. The claws of the fore feet are very large; the longest on the fore feet are sixteen lines, and the longest on the hind feet only seven. The trunk of the tail is three inches eight lines in length, and it is terminated and surrounded by long yellow hairs.

I am convinced that the American carcajou is the same animal with the European glutton, or at least that it is a species very nearly allied to the glutton. But I must remark, that I committed a mistake, occasioned by a similarity of names, and some natural habits, common to two different animals. I imagined that the kinkajou was the same animal with the carcajou. This error I discovered by seeing two animals, the one at the fair of St. Germain, in 1773, announced by a bill as *an animal unknown to all the naturalists,* which was true. Another altogether similar is now alive at Paris, in the possession of M. Chauveau, who brought it from New Spain. We believe it to be the true kinkajou, and have here given a figure of it. M. Chauveau imagined that it might be an accouchi or a coati. He remarks, indeed, that it has neither the long nose nor the annulated tail of the coati; but that it has the same hair, the same members, the same number of toes, and the same canine teeth, which are angular and chamfered on the sides. M. Chauveau acknowledges, that it differs from the coati by its prehensile tail, with which when descending it suspends itself, and adheres to every thing it can lay hold of.

'This animal,' says M. Chauveau, 'never stretches 'out his tail, unless when his feet are secure. He em'ploys it with greater dexterity in seizing and bringing 'to him such things as he cannot otherwise reach. He 'lies down and sleeps as soon as day appears, and awakes 'at the approach of night. His vivacity is then extremely 'great. He climbs with great facility, and searches 'about continually. He tears every thing he finds, 'either for amusement or in quest of insects. Were it 'not for this fault he might be left at liberty. Even 'before his arrival in France, he went about freely during 'the night, and next day he was always found lying 'in the same place. He may be wakened during the 'day; but the rays of the sun seem to be extremely 'incommodious to him. He is caressing, without being 'tractable: he distinguishes his master alone, whom he 'follows. He drinks water, coffee, milk, wine, and even 'aquavitæ; which last, when sugar is added to it, he 'drinks till he is intoxicated, and continues to be sick 'for several days. He eats indiscriminately bread, meat, 'pot-herbs, roots, and fruits. His common food, for a 'long time, has been bread soaked in milk, fruits, and 'pot-herbs. He is passionately fond of odours, sugar, 'and confections.

'He attacks poultry, and always seizes them under 'the wing. He seems to drink their blood; for he 'never devours them. When he has his choice he pre'fers a duck to a hen; and yet he is afraid of water. 'He has different cries: when alone during the night, 'he utters sounds nearly similar to the barking of a dog, 'and he always commences with sneezing. When he 'sports, or receives any injury, he cries like a young 'pigeon. When he threatens he whistles like a goose; 'and when enraged his cries are loud and confused. He 'is never in a passion but when hungry. His tongue, 'which he sometimes thrusts out, is immoderately long. 'The one in my possession was a female; and it is 'worthy of remark, that during the three years she has 'been in France she was only once in season, and was 'then extremely furious.'

The following is M. de Seve's description of a similar animal exhibited at the fair of St. Germain, in the year 1773.

'By its fur it has a greater resemblance to the otter 'than to any other animal; but its toes are not con'nected by membranes. The tail is as long as the body; 'but that of the otter is only half the length of its 'body. When walking, the length of its body gives it 'the air of a polecat. But the tail and figure of the head 'are different, and the latter has more resemblance to 'that of the otter. The eye is larger than that of the 'polecat. The face has some resemblance to that of the 'small Danish dog. His tongue is long, thin, and 'smooth. He appears to be of a mild disposition, and 'licks the hand of any person. Last Lent, when I drew 'its figure, it was very gentle; but it has been ren'dered mischievous by being frequently irritated by the 'populace. At present it sometimes bites after licking 'the hand. It is young, and its teeth seem not to be 'fully formed. It is of a restless disposition, and loves 'to climb, it often sits on end, scratches itself with its 'fore feet, like the apes, plays, folds its paws into each 'other, and performs many other monkey tricks. Like 'the squirrel it holds fruits and other food between its 'two paws. We neither give it flesh nor fish. When 'irritated it endeavours to leap upon the person, and its cry has a considerable resemblance to that of a large rat. Its fur has no odour. With great dexterity it hooks with its tail such things as it wants to lay hold of, and frequently hangs by the tail upon such bodies, as it meets with. I have remarked, that its toes, which are of a considerable length, spontaneously unite when it walks or climbs; and they spread not, like those of other animals, in the action of supporting itself. In fine, this animal, according to the account given by its master, came from the coast of Africa, where it was called *kinkajou*, and the species is said to be rare. This appellation, he supposed, was derived from the name of the island or country which it inhabits, being unable to learn any more from the person who sold it to him. I shall only say, that this kinkajou, which is a female, approaches nearer to the otter than to any other quadruped. Its hair is short and thick, mixed with some longer hairs. The hairs of the head, like those of the body and tail, are of an olive yellowish colour, mingled with gray and brown; and these colours vary according to the light in which they are viewed. The colour of each hair, through its greatest extent, is a grayish white, and a dusky greenish yellow at the point. The fur is mixed with other hairs, whose extremity is brown, beside large black hairs interspersed among the rest, which form bands on the sides of the eyes, and extend toward the front, and another band which vanishes near the neck. The eye is very similar to that of the otter. The pupil is small, and the iris is of a reddish colour. The muzzle is blackish brown, as well as round the eyes. As in small dogs the end of the nose is flat, and the nostrils are much arched. The teeth are yellow, and thirty-two in number. The canine teeth are very large, the superior crossing the inferior. There are twelve cutting teeth, four canine, and sixteen grinders. The ears are longer than broad, rounded at the points, and covered with short hair, of the same colour with that on the body. The sides, throat, and inside of the legs, are of a golden yellow colour, which is extremely vivid in some places. The same golden colour prevails on some parts of the head and hind legs. The belly is grayish white, tinged in some places with yellow. The tail, which is every where covered with hair, is thick at the origin, and gradually tapers to a point at the extremity. When walking the animal carries its tail horizontally. The under part of the paws is naked, and of a vermilion colour. The claws are white, hooked, and guttered below. The length of the whole animal is about two feet five inches.'

The similarity of the names *kinkajou* and *carcajou* led me, as well as other naturalists, to imagine, that they belonged to the same animal: in the following passage from Denis, formerly quoted in part only, where he tells us, that the kinkajou, which I then apprehended to be the carcajou, resembled the cat, I thought this traveller had been deceived; because all other travellers agree in making the figure of the carcajou similar to that of the glutton.

'The kinkajou,' says Denis, 'has some resemblance to the cat with brownish red hair. Its tail is long, and erected on its back in two or three folds. It has claws, and climbs trees, where it lies in wait along the branches to dart down on its prey. In this manner it seizes the orignal, invests him with its tail, and gnaws his neck till he falls. Notwithstanding the swiftness of the orignal, and the force with which he rubs against the trees and brushwood, the kinkajou never quits its hold; but if he can reach the water he is saved, because the kinkajou is then obliged to separate from him. Four years ago a kinkajou attacked one of my heifers, and cut its throat. The kinkajous are hunted by the foxes. They go in quest of the kinkajou when he lies in wait for the orignal, and never fail to carry him off.'

These facts correspond so well with the figure and description we have given of this animal, that we may presume they relate to the same animal, and that the carcajou and kinkajou are two distinct species, which have nothing in common except their darting upon the orignal and other quadrupeds, in order to drink their blood.

We formerly remarked, that the kinkajou was found in the mountains of New Spain: but he is likewise found in those of Jamaica, where the natives call him *poto*. Mr. Colinson sent me a figure of this poto or kinkajou, which I have inserted, together with the following notice:

'The body of this animal,' says Mr. Colinson, is red, mixed with ash-colour. The hair is short, but very thick, the head rounded, the muzzle short, naked, and blackish: the eyes are brown, the ears short and round, and the hairs round the mouth are long; but as they lie flat on the muzzle, they do not form whiskers. The tongue is narrow and long, and the animal often thrusts it three or four inches out of his mouth: the tail is of one uniform colour, and gradually tapers to a point: it is bended upwards when the animal walks, and has the prehensile faculty. The length of the creature is about fifteen inches, and that of the tail seventeen.

'This animal was taken in the mountains of Jamaica. He is mild, and may be handled without danger. He is drowsy during the day, and extremely vivacious in the night. He differs much from every other quadruped. His tongue is not so rough as that of the cat, or other animals of the *viverra* genus, to which he is related by the form of the head and claws. Round his mouth are many curled soft hairs, from two to three inches long. The ears are situated nearly opposite to 'the eyes. When he sleeps he rolls himself up into a 'ball, like the hedgehog, with his fore feet under his 'cheeks. With his tail he can draw a weight equal to 'that of his own body.'

From comparing the two figures, and the descriptions of Mr. Colinson and of M. Simon Chauveau, it is evident, that they both relate to the same animal, except some slight varieties, which change not the species.

THE MOUFFETTES, OR STINKING POLECATS.

We have given the generic name *mouffette* to three or four species of animals, which, when disturbed, send forth an odour so strong and offensive, that it suffocates like the subterraneous vapour called *mouffette*. These animals are found in all the southern and temperate regions of America.

['But above all I cannot pass over without mentioning a little creature with a bushy tail, which we call a *huffer*, because when he sets sight on you, he stands vapouring and patting with his fore feet upon the ground, and yet hath no manner of defence for himself but with his breech; for upon your approaching near him he turns about his backside and squirts at you, accompanied with the most abominable stink in the world.'—*Dampier*.

In Peru there are numbers of small foxes, some of which send forth an intolerable smell. During the night they come into the towns, and, however close the windows, their odour is felt at the distance of a hundred paces. Happily their number is not great, otherwise they would stink the whole world.—*Hist. des Incas*.]

These animals have been indistinctly mentioned by travellers under the names of *stinking beasts, devil's children*, &c. and not only confounded with each other, but with animals of very different species. Hernandes has pretty clearly pointed out three of them. The first he calls *ysquiepatl*, a Mexican name, which, were it easily pronounced, we would retain. He has given a description and figure of it; and it is the same animal of which we have also a figure in Seba. We shall call it *coase*, from the name *squash*, which it receives in New Spain. The second Hernandes likewise calls *ysquiepatl*, which we shall denominate *chinche*, from the name it obtains in South America. [The skunk weasel, with short rounded ears, black cheeks, and a white stripe from the nose, between the ears, to the back. The upper part of the neck, and the whole back, are white, divided at the bottom by a black line, commencing at the tail, and passing a little way up the back. The belly and legs are white. The tail is very full of long coarse hair, generally black, and sometimes tipped with white; that figured by M. de Buffon is entirely white. It has very long nails on all the feet, like those on the fore feet of a badger. It is somewhat less than the European polecat.—*Pennant*.] The third Hernandes calls *conepatl*, which name we shall preserve, and is the same animal with that given by Catesby, under the denomination of the *American polecat*, and by Brisson, under that of the *striped polecat*. We are acquainted with a fourth species, which we call *zorilla*, the name it receives in Peru and other parts of South America.

[The American polecat in shape is not unlike our common polecat, except that the nose of this is somewhat longer. The colour of all I have seen is black and white, though not always alike marked. This had a list of white, extending from the hind part of the head, along the ridge of the back, to the rump; with four others, two on each side, running parallel with it.—*Catesby*.]

We are indebted for our knowledge of two of these animals to M. Aubry, whose taste and skill in natural history are conspicuous in his cabinet, which is one of the most curious in Paris. He obligingly communicated to us all his treasures as often as we required them; and this will not be the only opportunity we shall have of expressing our gratitude. The animals we borrowed from M. Aubry, in order to have them drawn and engraved, are the coase, the chinche, and the zorilla; the two last of which may be regarded as new, because there is no figure of them to be found in any author.

The first of these animals was transmitted to M. Aubry under the name of *pekan, devil's child*, or *wild cat of Virginia*. I perceived that it was not the pekan, rejected all the compound denomination, and discovered that it was the *ysquiepatl* of Hernandes, and the *squash* of other travellers; from which last appellation I derived the name *coase*. It is about sixteen inches long, including the head and body. The legs are short, the muzzle thin, and the ears small. The hair is of a deep brown colour, and the claws are black and sharp. It lives in the holes and clefts of rocks, where the female brings forth her young. It feeds upon beetles, worms, and small birds; and when it gets admission to the court-yards it destroys the poultry, of which it only eats the brain. When afraid or irritated it emits an odour so abominable, that neither men nor dogs dare approach. Its urine, which apparently mingles with this pestiferous odour, stains and infects in an indelible manner. It appears, however, that this disagreeable odour is not constant: 'This animal,' Seba remarks, 'was sent me alive from Surinam; and I kept it during a whole summer in my garden, where it was secured by a small chain. It never bit any person; and when it was presented with food, it allowed itself to be handled like a small dog. It dug the earth with its snout and fore feet, which were armed with long crooked claws. During the day it concealed itself in a kind of den which it had made. It came out in the night, and after trimming itself began to run about from right to left as far as its chain would permit; and this exercise it continued till morning. It searched every where with its nose on the ground. It was served with victuals every night, and never took any food but what was agreeable to its nature. It was not fond of flesh, bread, and several other kinds of nourishment. Maybugs, boiled shrimps, caterpillars, and spiders, were its chief delicacies. About the end of autumn it was found dead in its hole, being unable to endure the cold. The hair on the back is of a deep chesnut colour; the ears are short; the forehead is round, and of a brighter colour than the back; and the belly is yellow. The tail is of a moderate length, covered with short brown hair, and a kind of yellowish rings were perceptible all round it.'

Though Seba's description and figure correspond very well with those of Hernandes, it may be doubted whether they relate to the same animal; because Seba makes no mention of the detestable odour, which he must unquestionably have perceived in the course of a whole summer, during which he kept the animal in his garden. But no such doubt will remain, after we are informed, that this animal does not send forth its disagreeable odour unless when irritated or frighted; and that it is often tamed and kept in houses by the inhabitants of different parts of America.

['Notwithstanding the offensive quality of these animals they are sometimes tamed by the English, French, Swedes, and Savages of North America. They are said to follow their masters like domestic animals, and that they do not throw out their urine, unless when beat or irritated. When a Savage kills any of them he cuts out the bladder, to prevent their flesh, which is good eating, from being infected with the smell of urine. I often met with English and French, who informed me, that they had eaten this flesh, and found it to be very well tasted, approaching nearly to the flavour of a pig. The Europeans put no value on the skin, on account of the length and coarseness of the hair; but the Savages make purses of it.'—*Kalm's Travels.*]

Of these four species of *mouffettes,* to which we have given the name of *coase, conepate, chinche,* and *zorilla,* the two last belong to the warmest climates of South America, and may be varieties only, and not distinct species. The two first inhabit the more temperate climates of New Spain, Louisiana, the Illionois, Carolina, &c. and appear to be different species, particularly the coase, which has only four toes on the fore feet, while all the others have five. But all these animals have the same figure, the same instincts, the same pestiferous odour, and may be said to differ only in the length and colour of their hair. The coase is of a pretty uniform brown colour. The conepate, upon a black ground colour, has five white bands which extend longitudinally from the head to the tail.

'The English denominate *polecat* a species of animal which is common not only in Pennsylvania, but in several other more northern and southern provinces of America. In New York its vulgar name is *skunck;* and the Swedes in that country call it *fiskatte.* This animal has a great resemblance to the martin, and is generally of a black colour, with three white bands which run longitudinally from head to tail. Some of them have been seen, though rarely, almost entirely white. This animal brings forth its young in burrows, or in hollow trees: it continues not always on the ground, but mounts upon trees. It is an enemy to birds; for it breaks their eggs and eats their young. When it gets admission to a hen-house it makes great havock. When hunted, either by men or dogs, he runs as well as he can, or climbs up a tree; and when hard pushed he darts forth his urine against his pursuers. The odour of his urine is so strong that it suffocates. If a drop of this pestiferous fluid falls upon the eyes, the person is in danger of losing his sight; and when it falls upon a man's clothes it is extremely difficult to extract the smell. Most dogs fly from him the moment they feel this odour. It requires more than a month to remove the smell from stuffs of any kind. In the woods it is often felt at a great distance. In the year 1749 one of these animals came near the place where I lodged. It was in winter and during the night. The dogs were wakened and pursued it. In a moment it diffused an odour so fetid that I was almost suffocated in my bed, and the cows bellowed in a hideous manner. About the end of the same year another of them slipt into our cave; but it diffused not the smallest odour, which it never does, unless when pursued or irritated. A woman perceived its eyes sparkle in the dark, and killed it. The cave was instantly filled with such a noxious odour, that the woman was not only sick for several days, but the bread, meat, and other provisions, were so infected, that they were obliged to be thrown away.'—*Kalm's Travels.*]

The chinche is white on the back, and black on the flanks, with a head entirely black, except a white line which extends from the nap of the neck to the chanfrin of the nose. Its tail is bushy, and covered with very long white hair, mixed with a little black.

[This animal was called *chinche* by the natives of Brasil. It is of the size of a cat. Its head is long, and tapers toward the end of the upper jaw, which advances beyond the under, and both form a mouth that extends to the external angles of the eyes, which are long and narrow: the uvea is black, and all the rest white. The ears are large, and nearly resemble those of a man, and their whole structure indicates a delicate sense of hearing. Two white bands arise on the head, pass over the ears, and, receding from each other, terminate in an arch upon the sides of the belly. Its legs are short, and the paws are divided into five toes, armed with black claws, with which it digs holes in the earth. Its back is arched like that of a hog, and its belly is flat. The tail is of equal length with the body, and differs not from that of the fox. The hair is of a dark gray colour, and as long as that of a cat. It burrows in the earth like a rabbit; but its hole is not so deep. I have had much difficulty in extracting the bad smell of this animal from my clothes which had been infected by it. Though several times washed, soaked, and dried in the sun, it continued more than eight days. I was informed that this smell proceeds from the animal's urine, which it discharges on its tail, and by this means disperses it all around, in order to put the enemy to flight by the intolerable stench; that for the same purpose it urines in the entry to its habitation; that it is very fond of small birds and poultry; and that it is the chief cause of the destruction of birds in the country of Buenos-Ayres.—*P. Feuillee. Note.* The chinche appears to be the same animal with the *chincille* mentioned by Acosta. 'The chincilles,' he remarks, 'are small animals like squirrels, and their hair 'is wonderfully soft and smooth. They are found in 'the Sierre of Peru.'—*Hist. Not. des Indes Occid.*]

The zorilla, which is called *mapurita*, seems to be a smaller species. Its tail, however, is as bushy and as beautiful as that of the chinche, from which it differs in the disposition of the spots in the fur. The ground colour of the zorilla is black, upon which there are longitudinal white bands, extending from the head to the middle of the back, and other transverse white bands on the flanks, the crupper, and the origin of the tail, which is black as far as the middle, and then white to the extremity; but the tail of the chinche is of one uniform colour.

[The zorilla of New Spain is as large as a cat, with black and white hair, and a very fine tail. When pursued it discharges its urine as a defence; for the stench of this excretion is so strong, that it poisons the air all around to the distance of a hundred paces, and prevents the enemy from advancing. If it falls upon clothes they must be buried for some time under the ground in order to remove the stench.—*Gemelli Carreri.*

The mapurita is an animal on the banks of the Oronooko, and is perhaps the most beautiful, and at the same time the most detestable, of all creatures. The whites of America call it *mapurita*, and the Indians *matufatiliqui.* Its body is all spotted with black and white, and its tail is adorned with beautiful hair. It is an active, mischievous, and strong animal. The stench of its odour, which extends to a great distance, is so intolerable, that I was once almost suffocated by it. The Indians, however, eat its flesh, and adorn themselves with its skin, which has no bad smell.—*Gumilla.*

In Louisiana there is a small animal of considerable beauty, but whose urine poisons the air to the distance of more than a league; for this reason it is called the *stinking beast.* It is as large as a cat. The male is of a fine black colour; the female is likewise black, and spotted with white. Its eyes are extremely vivacious. It is justly denominated *stinking;* for its odour is infectious. I once killed one of these animals, and my dog having darted upon it returned and fawned upon me. A drop of the blood, and doubtless also the urine, was left upon my coat, which was made of hunting ticking. The smell was so intolerable that I was obliged to run home and to change my clothes, &c.—*Hist. de la Louisiane.* When one of these animals is attacked by a dog, to appear formidable it so changes its usual form, by bristling up its hairs, and contracting its length into a round form, that it makes a very terrible appearance. This menacing behaviour, however insufficient to deter its enemy, is seconded by a repulse far more prevailing; for from some secret duct it emits such fetid effluvia that the atmosphere, for a large space round, shall be so infected with them that men and other animals are impatient till they are quit of it. This stench is insupportable to some dogs, and necessitates them to let their game escape; others, by thrusting their noses into the earth, renew their attacks till they have killed it, but rarely care to have more to do with such noisome game, which for four or five hours distracts them. The Indians, notwithstanding, esteem their flesh a dainty, of which I have eat, and found it well tasted. I have known them brought up young, made domestic, and prove tame and very active, without exercising that faculty which fear and self-preservation perhaps only prompt them to. They hide themselves in hollow trees and rocks, and are found in most of the northern continent of America. Their food is insects and wild fruit.—*Catesby.*]

All these animals are nearly of the same figure, and of the size of an European polecat, which they resemble still more in their manners. The physical results of their organization are likewise the same. Of all the animals on this continent the polecat diffuses the most disagreeable odour. This odour is only more exalted in the mouffettes, whose species or varieties are numerous in America. But in the Old Continent the species of the polecat is single; for I believe not that the animal mentioned by Kolbe, under the name of the *stinking badger*, which appears to be a real mouffette, exists at the Cape of Good Hope as a native of that country. It may have been transported from America; and Kolbe, who is by no means exact in his facts, may have borrowed his description from P. Zuchel, whom he quotes as having seen this animal in Brasil. That of New Spain, called *ortohua* by Fernandez, seems to be the same animal with the zorilla of Peru; and the *tepemaxtla* of the same author may be the conepate, which ought to be found in New Spain, as well as in Louisiana and Carolina.

THE PEKAN, AND THE VISON.

PEKAN weasel, with very long and strong whiskers; ears a little pointed; hair on the head, body, belly, and legs, cinereous at the roots, and of a bright bay at the ends, very soft and glossy. Between the fore legs there is a white spot. The toes are covered with thick hair above and below. The claws are sharp. The tail is of a deeper colour than the body. In form it is like a martin, but much less.

The name *pekan* was long familiar in the fur trade of Canada, without knowing the animal to which it properly belonged. This name is not to be found in the writings of the naturalists, and travellers have employed it indiscriminately to denote different animals, and particularly the mouffettes. By others the animal which ought to bear the name of pekan has been called a *fox* or a *wild cat;* and it was impossible to derive any precise knowledge from such short and erroneous intimations. With regard to the *vison* we are equally ignorant. We know nothing of these names, except that they belong to two North American animals. We found these two animals in the cabinet of M. Aubry, who obligingly permitted us to describe and draw them.

The pekan has so strong a resemblance to the pine weasel, and the vison to the martin, that they may be regarded as varieties of these species. They not only have the same figure, the same proportions, the same length of tail, the same quality of hair, but the same number of teeth and claws, and the same instinct and manners. Hence we may conclude, that the pekan is a variety of the pine weasel, and the vison a variety of the martin, or at least that the species are so allied that they exhibit no real differences. The hair of the pekan and vison is only browner, and more lustrous and silky than that of the pine weasel and the martin. But this difference, it is well known, is common to them with the beaver, the otter, and other animals of North America, whose furs are more beautiful than those of the same animals in the north of Europe.

THE SABLE.

SABLE weasel, with long whiskers, rounded ears, and long bushy tail. The colour of the hair is black at the tips, and cinereous at the bottom; the chin is cinereous, and the edges of the ears yellowish. Sometimes the hair is of a tawny cast; for in spring, after shedding the coat, the colour varies. There are instances of their being found of a snowy whiteness. The usual length, from nose to tail, is about eighteen inches, and that of the tail ten.

The sable is mentioned by almost every naturalist, without knowing more of it than the skin. M. Gmelin is the first who gave a figure and description of this animal. He saw two of them alive in the house of the governor of Tobolski. 'The sable,' says he, 'resembles 'the martin in the form and habit of body, and the 'weasel in the teeth. It has six cutting teeth pretty 'long and a little crooked, and two canine in the under 'jaw, and small sharp teeth in the upper. It has long 'whiskers round the mouth, and large feet, all armed 'with five claws. These characters were common to 'both the sables. But the one was of a blackish brown 'colour all over the body, except the ears and below the 'chin, where the hair was a little yellow. The other 'was smaller, and of a yellowish brown colour, with the 'ears and under part of the chin of a paler cast. These 'are their winter colours; for in spring they change by 'the shedding of the hair. The first sable, which was 'of a blackish brown, changes into a brownish yellow 'in spring; and the second, which was of a yellowish 'brown, becomes a pale yellow. I admired,' continues

M. Gmelin, 'the agility of these animals. Whenever they 'perceive a cat, they rise upon their hind feet, to prepare for the combat. In the night, they are extremely 'restless and active. During the day, on the contrary, 'and particularly after eating, they generally sleep half 'an hour or an hour, when they may be pushed, shaken, 'and even pricked, without awaking.' From this description we learn, that the sables are not all of the same colour; and, consequently, that the nomenclators, who describe them by the spots and colours of the hair, have employed a fallacious character; for their colour not only varies in different seasons, but the individuals of the same and of different climates differ from each other.

The sables inhabit the banks of rivers, and the thickest parts of the woods. They leap with great agility from tree to tree, and avoid the rays of the sun, which are said, in a short time, to change the colour of their hair. It is pretended, that they conceal themselves, and lie in a torpid state during the winter; and yet this is the best season for hunting them, because their fur is then better and more beautiful than in summer. They live upon rats, fishes, pine tops, and wild fruits. They are very ardent in their amours: during their season of love, they emit a strong odour, and their excrements at all times, have a disagreeable smell. They are chiefly found in Siberia: there are not many of them in the forests of Great Russia, and still fewer in Lapland. The blackest sables are most esteemed. The sable differs from all other furs in this circumstance, that the hair turns with equal ease to any side.

[Of the two sables mentioned by M. Gmelin, the first came from the province of Tomskein, and the second from that of Beresowien. We likewise learn, from his account of Siberia, that there are on the mountains of Sopka Sinaia, black sables with short hair, the hunting of which is prohibited; and that a similar kind is also found in the more advanced mountains, as well as among the Calmucks Vrangai. 'I saw,' says he, 'some of 'their skins which the Calmucks had brought down: 'they are distinguished by the name of *Kangaraga* '*sables.'—Gmelin.*

The sable differs from the martin by being smaller, and have finer and longer hair. The true sables are damasked with black, and are taken in Tartary. There are few of them in Lapland. The fur is esteemed in proportion to the blackness of the hair, and sometimes sells at sixty crowns, though the width of the skin exceeds not four inches. Some of them have been seen white, and others gray.—*Regnard.* Scheffer likewise remarks, that white sables are sometimes found.

The hunting of the sables is carried on by criminals confined to Siberia, or by soldiers sent for the purpose, who generally remain there several years. Both are obliged to furnish a certain quantity of furs. They shoot with a single ball, to injure the skin as little as possible; and sometimes, instead of fire-arms, they use cross-bows and small arrows. As the success of this hunting requires much address and assiduity, the officers are allowed to encourage the soldiers, by giving them a proportional part of all the sables they kill above what they are obliged to furnish weekly, which turns out to be a considerable premium.

[A colonel, from seven years service in hunting sables, may draw, of clear profit, four thousand crowns, the subalterns in proportion, and each soldier six or seven hundred.—*Voyage du P. Avril.*]

Some naturalists have suspected that the sable is the *satherius* of Aristotle; and I believe their conjecture is well founded. The fineness of the fur is a proof that the animals are often in water; and travellers inform us, that they are never very numerous, but in small islands, where the hunters go in quest of them. Besides, Aristotle mentions the satherius as a water animal, and ranks it with the otter and beaver. It is likewise to be presumed, that, when Athens was in its splendor, these beautiful furs were known in Greece, and that the animal which furnished them had a name. Now, there is no name which can more properly be applied to the sable, than that of *satherius,* especially if it be true that the sable eats fish, and continues so much in the water as to be reckoned amphibious.

SUPPLEMENT.

To the article sable we have nothing to add, but some facts related by the Russian travellers, which are published in the last volumes of the *Hist. Gen. des Voyages.*

'The sables live in holes of corrupted trees, or under 'their roots, or on rocky eminences. Their nests are 'constructed with moss, branches of trees, and turf. 'In these holes or nests, they continue twelve hours, 'both in summer and winter. The remainder of their 'time is occupied in quest of subsistence. In spring, 'they feed upon weasels, ermines, squirrels, and especially hares. But, in the fruit season, they eat bay-'berries, and the fruit of the service-tree. In winter, 'they catch small birds and woodcocks. When the 'snow falls, they retire to their holes, where they remain 'sometimes three weeks. They copulate in the month 'of January. Their amours continue one month, and 'often produce bloody combats between the males. 'After copulation, they remain in their nests about 'fifteen days. The females bring forth about the end 'of March, and produce from three to five young, whom 'they suckle four or six months.

'The hunters go in companies of forty, in quest of 'these animals during the winter only, and use canoes, 'with provisions for three or four months. They have 'a chief, who, when they arrive at the rendezvous, 'assigns to each band a particular quarter, and all the 'hunters are obliged to obey him. The snow is removed 'from the places where the snares are to be laid; and 'each hunter prepares twenty of them daily. The 'hunters choose a small spot in the vicinity of trees, 'surround it, to a certain height, with sharp stakes, and 'cover it with thin planks, to prevent the entrance of 'the snow. They leave a narrow passage, above which 'is placed a beam, supported only by a small twig; and, 'as soon as the sable touches it, to carry off the piece of 'flesh or fish, put there for a bait, the beam falls and 'kills the animal. All the sables are brought to the 'general conductor; or, rather, they are concealed in 'the holes of trees, to prevent the Tongusians, or other 'savage people, from stealing them. When the sables 'are averse to enter these snares, the hunters have re'course to nets. When a hunter discovers the track of 'a sable, he follows it till he discovers its hole, and, by 'means of smoke, obliges the animal to come out. He 'then extends his net; and continues lying in wait, in 'this manner, with his dogs, for two or three days suc'cessively. This net is thirteen fathoms long, and four 'or five in height. When the sable leaves its hole, it 'seldom escapes; for the dogs slay it when entangled 'by the net. When discovered on the trees, the hunter 'shoots them with blunt arrows, to prevent the skins 'from being injured. The hunting being finished, the 'company assemble at the general rendezvous, and 'reimbark as soon as the rivers become navigable by 'the melting of the ice.'

THE LEMING, OR LAPLAND MARMOT.

LAPLAND marmot, with two very long cutting teeth in each jaw; head pointed; long whiskers; six of the hairs on each side longer and stronger than the rest; eyes small and black; mouth small; upper lip divided; ears small, blunt, and reclining backwards; fore legs very short; four slender toes on the fore feet, covered with hairs; and, in the place of the thumb, a sharp claw, like a cock's spur; five toes behind; tail about half an inch long, the body and head about five. The skin is very thin. The colour of the head and body is black and tawny, disposed in irregular blotches. The belly is white, tinged with yellow.

Olaus Magnus is the first who mentions the leming. All that Gessner, Scaliger, Ziegler, Johnston, &c. have said concerning it, is borrowed from this author. But Wormius, after the most accurate researches, has written a history of this animal, which he describes in the following manner: 'It has,' he remarks, 'the figure 'of a mouse; but the tail is shorter, and the body about 'five inches long. The hair is fine, and spotted with 'various colours. The fore part of the head is black, 'and the hind part yellowish. The neck and shoulders 'are black. The rest of the body is reddish, and marked 'with small black spots of different figures, as far as the 'tail, which exceeds not half an inch in length, and is 'covered with blackish yellow hairs. Neither the 'figure, nor the order of the spots, are the same in 'every individual. Round the mouth there are several 'stiff hairs in the form of whiskers, of which six on 'each side are longer and stiffer than the rest. The 'opening of the mouth is small, and the upper lip is 'divided, as in the squirrels.' From the upper jaw pro'ceed two long, sharp, and somewhat crooked cutting 'teeth, the roots of which penetrate as far as the orbits 'of the eyes. Two similar teeth in the under jaw 'correspond with those above; and there are three 'grinders on each side, situated at a distance from the 'cutting teeth. The first of the grinders is large, and 'composed of four lobes, the second of three lobes, and 'the third is much smaller. Each of these three teeth 'has a separate socket, and they are placed in the palate, 'at a considerable distance from one another. The 'tongue is pretty large, and extends to the extremity of 'the cutting teeth. From the remains of herbs and 'straw found in its throat, we are inclined to think that 'it is a ruminating animal. The eyes are small and 'black, and the ears recline on the back. The fore legs 'are very short, and the feet covered with hair, and 'armed with five sharp, crooked claws; the middle one 'is very long, and the fifth is like a small thumb, or a 'cock's spur, and sometimes situated equally high on 'the leg. The whole belly is whitish, inclined to yel'low,' &c.

These animals, though their body is thick, and their legs very short, fail not to run pretty quickly. They generally inhabit the mountains of Norway and Lapland; but, in particular years, they sometimes descend in such numbers, that the arrival of the lemings is considered as a terrible scourge, the effects of which it is impossible to avoid. They make dreadful devastation in the fields, lay waste the gardens, ruin the crops, and leave nothing except what is shut up in houses, where they happily never enter. They bark nearly like small dogs. When struck at with a stick, they seize it so forcibly with their teeth, that they allow themselves to be carried to a considerable distance without quitting their hold. They dig holes in the earth, and make roads, like the moles, in quest of roots. At particular times they assemble together, and the whole die in company. They are very courageous, and defend themselves against other animals. It is not known from whence they come. The male is generally larger than the female, and his black spots are also larger. Upon the renewal of the grass they infallibly die. In fine weather they take to the water in vast multitudes; but when a breeze of wind rises they are all drowned. The number of these animals is so prodigious, that when they die the air is infected, and produces many diseases. They even seem to infect the plants which they gnaw; for the pasture then kills the cattle. The flesh of the lemings is not good; and their skin, though the hair be fine, does not answer for making furs, because it is too thick.

[It has been remarked, that the lemmers appear not regularly every year, but at certain unforeseen periods, and in such numbers that they spread every where, and cover the whole surface of the earth. These small animals, instead of being afraid, or flying from passengers, are bold and obstinate, face those who attack them, and cry and yelp nearly in the same manner as small dogs. When attacked they neither fear clubs nor halberbs, but dart against those who strike them, outrageously biting, and fixing upon the weapons employed to kill them. These animals, it is singular, never enter the houses or huts to do mischief, but keep always concealed among the bushes and hillocks. They sometimes make war, and divide themselves into two armies along the lakes and meadows. Their enemies are foxes and ermines, who devour great numbers of them. Grass that has been eat down, and springs again, is said to kill them; and they seem likewise to commit suicide; for they are often found suspended on the branches of trees; and they probably throw themselves in troops into the waters, like the swallows.—*Hist. de la Lapponie. Note*—It would appear that the lemings, like the rats, mutually destroy and eat one another when pasture fails them; and that this is the reason why their destruction is as sudden as their multiplication.

THE SEA OTTER.

SEA otter, with a black nose; upper jaw longer and broader than the lower; long white whiskers; irides hazel; ears small, erect, and conic. In each jaw there are four cutting teeth. The grinders are broad, adapted for breaking and comminuting crustaceous animals and shell fish. The skin is thick. The hair is long, thick, and excessively black and glossy, beneath which is a soft down. The colour sometimes varies to silvery. The legs are thick and short. The toes are covered with hair, and joined by a web. The hind feet are exactly like those of a seal, and have a membrane skirting the outside of the exterior toe, like that of a goose. The length, from nose to tail, is four feet two inches. The tail is thirteen inches long, flat, fullest in the middle, and sharp pointed. The biggest of these animals weigh seventy or eighty pounds.

'The *saricovienne*,' (or sea otter), says Thevet, 'is 'found along the river Plata. It is of an amphibious 'nature, living more in the water than upon land. This 'animal is as large as a cat; and its skin, which is a 'mixture of gray and black, is as fine as velvet. Its feet 'resemble those of water-fowl; and its flesh is extremely 'good and delicate.' I begin with the above passage, because the animal is unknown to the naturalists under this name, and because they know not that the *cariguei-beju* of Brasil, which is the same animal, has membranes between the toes. Marcgrave, indeed, who gives a description of it, mentions not this character, which is an essential one, since it brings this species as near as possible to that of the otter.

Besides, I believe that the animal mentioned by Gumilla under the name of *guachi*, may be the same with the saricovienne, which is a species of otter common throughout all South America. From the description given of it by Marcgrave and Desmarchais, it appears, that this amphibious animal is as large as a middle-sized dog; that the top of its head is round like that of the cat; that its muzzle is somewhat long, like that of the dog; that it has the teeth and whiskers of a cat; small, round, black eyes, ears roundish, and placed low; five toes on each foot, with the thumbs shorter than the other toes, which are all armed with sharp brown claws. The tail is as long as the hind legs. The hair is pretty short and very soft. It is black on the body and brown on the head, with a white spot under the chin. Its cry is nearly like that of a young dog; and it is sometimes interrupted by another cry similar to that of the sagoin, or fox-tailed monkey. It feeds upon crabs and fishes; but it may likewise be nourished with the flour of manioc diluted in water. Its skin makes a good fur; and though it lives chiefly on fishes, its flesh is very good, wholesome, and has no bad flavour.

[On the rivers which fall into the Oronoko there are a great many water dogs which the Indians call *guachi.* This animal swims swiftly, and feeds upon fishes. It is amphibious; but goes likewise in quest of food upon the land. It digs ditches on the banks, where the female brings forth her young. These ditches are not made in retired places, but where the animals live in common, and come to amuse themselves. I carefully examined their habitations, and found them to be always exceedingly clean. They leave not the smallest herb in the neighbourhood. They heap up at a distance the fragments of the fishes they eat, and by leaping, going, and returning, they make the roads extremely neat and commodious.—*Hist. de l'Orenoque. Note*—These characters correspond with the saricovienne; but the name *guachi* seems to be here improperly applied, because it probably belongs to a species of mouffette, which we have called the *coase.*]

THE CANADIAN OTTER.

THIS otter, which is much larger than ours, and ought to be found in the north of Europe as well as in Canada, affords me an opportunity of enquiring whether it is the same animal with the *latax* of Aristotle, which, he remarks, is much larger and stronger than the common otter. But the ideas he gives of it correspond not entirely with this large otter; and finding that it was perfectly similar to the common otter, except in size, I thought it was not a particular species, but a simple variety: and as the Greeks, and especially Aristotle, were careful not to give different names but to distinct species, we are persuaded that the *latax* is another animal. Besides, as the otters, like the beavers, are generally larger, and have finer and blacker hair in America than in Europe, this otter of Canada ought to be longer and blacker than the French otter. But on considering what the *latax* of Aristotle might be, I conjectured that it was the animal mentioned by Belon, under the name of the *sea wolf.*

['As the English have no land wolves, nature has furnished them with an animal that frequents the shores of their seas, which makes so near an approach to our wolf, that if it did not prefer fishes to sheep, we would reckon it to be the very same, whether we consider its size, its hair, its head, (which is always large,) or its tail. But as this animal, he remarks, lives only on fishes, and was unknown to the ancients, it seems to be no less singular than the double lived animals mentioned above; for which reason I have given a figure of it.'—*Belon. Note.* The figure resembles the hyæna more than any other animal; but it could never be the hyæna; for he is not amphibious; neither does he live on fishes; and besides he belongs to a different climate.]

Aristotle has mentioned six amphibious animals; and of these six we know only three, the common seal, the beaver, and the otter. The other three, namely, the *latax,* the *satherion,* and the *satyrion,* remain unknown, because they are only pointed out by their names, without any description. In this case, as in all those where no direct induction can be derived from a knowledge of the object, we must have recourse to the mode of exclusion; but this mode can never be employed with success, except when we know nearly the whole subject. For example, from long study I believe that I am acquainted with nearly the whole quadruped tribe. I know that Aristotle could have no information concerning those which are peculiar to the continent of America. Of the quadrupeds I likewise know all those which are amphibious: from these I in the first place strike off all those which belong to America, as the tapir, the cabiai, the ondatra or musk-rat, &c. There remain only the amphibious animals of our own continent, which are, the hippopotamus, the walrus or sea-cow, the seals or sea-calves, the sea-wolf of Belon, the beaver, the otter, the sable, the water rat, the Muscovy musk-rat, the water shrew mouse, and, if you choose, the ichneumon, which some authors have regarded as an amphibious animal, and called it the *Egyptian otter.* From this number I retrench the walrus or sea-cow, which being found only in the northern seas, was unknown to Aristotle. I likewise retrench the hippopotamus, the water rat, and the ichneumon, because he mentions them elsewhere under their proper names. Lastly, I retrench the seals, the beaver, and the otter, which are well known, and the water shrew-mouse, which is too similar to the land one ever to have received a separate name. There remain then, the sea wolf of Belon, the sable, the Muscovy musk rat, for the *latax,* the *satherion,* and the *satyrion.* Of these three animals the sea wolf of Belon alone is larger than the otter: hence it alone can represent the *latax;* and consequently the sable and the Muscovy musk rat must represent the *satherion* and the *satyrion.* These conjectures, which I believe to be well founded, are not, however, of the number of those which time can elucidate, unless some Greek manuscripts, hitherto unknown shall be discovered where these names are employed, and new explications given of them.

THE SEALS, THE WALRUS, AND THE MANATI.

LET us assemble, for a moment, all the quadrupeds into one group, and let the intervals or ranks represent the proximity or distance between each species. Let us place in the centre, the most numerous genera, and on the flanks those which are least numerous. Let us confine the whole within narrow bounds, that we may have the more distinct view of them; and we shall find, that it is impossible to round this inclosure. Though all quadrupeds are more closely connected together than to any other being; yet several of them make prominent points, and seem to fly off in order to join other classes of animated nature. The apes make a near approach to man. The bats are the apes of birds, which they imitate in their flight. The porcupines and hedgehogs, by the quills with which they are covered, seem to indicate that feathers are not confined to birds. The armadillos, by their scaly shells, approach the turtle and the crustaceous animals. The beavers, by the scales on their tails, resemble the fishes. The ant-eaters, by their beak or trunk without teeth, and the length of the tongue, claim an affinity to the fishes. In fine, the seal, the walrus, and the manati, are a separate corps, and make a great projection, with a view to arrive at the cetaceous tribes.

Seal, walrus, and *manati*, are rather generic than specific denominations: Under the seal we shall comprehend, 1. The *phoca* of the ancients, which is probably that we have represented in the figure: 2. The common seal, or sea-calf. 3. The great seal, of which Mr. Parsons has given a figure and description in the *Philosophical Transactions*, No. 469. 4. The very large seal, or *sea-lion*, described and painted by the author of Anson's voyage.

Under the name *walrus*, we comprehend the animals commonly called *sea-cows*, or *sea-horses*, of which we know two species, the one found only in the northern, and the other in the southern seas; the last is called *dugon* or *Indian walrus*. In the last place, under the term *manati*, we comprehend the animals called *lamantins*, or *sea-oxen*, in St. Domingo, Cayenne, and other parts of South America, as well as the *lamantin* of Senegal, and other parts of the coast of Africa, which appears to be only a variety of the American kind.

The seal and walrus are more nearly allied to the quadrupeds than to the cetaceous animals; because they have a kind of four feet. But the manati, which have only two fore-feet, resemble the cetaceous tribes more than the quadrupeds. Both differ from other animals by a singular character: they alone can live equally in air and in water; and, consequently, they alone merit the appellation of *amphibious*. In man, and the other terrestrial viviparous animals, the *foramen ovale* of the heart, which permits the fœtus to live without respiration, closes the moment after birth, and remains shut during life. In the seal and walrus, on the contrary, it is always open, though the mothers bring forth their young on land, and respiration commences immediately after birth, as in all other animals. By means of this perpetual aperture in the *septum* or partition of the heart, which allows a communication of the blood from the vena cava to the aorta, these animals enjoy the privilege of respiring, or not, at their pleasure. This singular power is common to the whole of them: but each possesses peculiar faculties, which shall be pointed out, as far as we have been able to learn, in the history of the particular species.

THE SEALS.

In general, the seals, like man, have a round head; a broad muzzle, like the otter; large high placed eyes; small or no external ears, being only two auditory passages on each side of the head; whiskers round the mouth; teeth similar to those of the wolf; the tongue forked at the end; a fine neck; the body, hands, and feet covered with short and pretty coarse hair; no apparent arms, but rather two membranes or skins, investing five fingers, and terminated by five claws; two feet without legs, and perfectly similar to the hands, except that they are larger, and turn backward to unite with a very short tail, which they accompany on each side; a long body, like that of a fish, but thick at the breast, narrow at the belly, without haunches, crupper, or thighs. The structure of this animal is so strange, that it served as a model, upon which the imagination of the poets framed the Tritons, Sirens, and Sea-gods, with a human head, the body of a quadruped, and the tail of a fish. The seal, in effect, reigns in this mute empire, by his voice, his figure, his intelligence, and his talents, which are common to him with the inhabitants of the land, and render him so superior to the fishes, that they seem not only to belong to another order of beings, but to a different world. This amphibious animal, though his nature be very distant from that of our domestic animals, is susceptible of a species of education. He is reared by keeping him often in water; he is taught to give a salute with his head and his voice; he comes when called upon, and exhibits several other marks of intelligence and docility.

His brain and cerebellum are proportionally larger than in man. His senses are as good as those of any quadruped; and consequently his sensations are equally vivacious, and his intellect equally active: both are exhibited in the gentleness of his manners, his social dispositions, his affection for the female, his attention to his offspring, and in the expressive modulation of his voice, which is superior to that of any other animal. He is also endowed with strength and weapons of defence. His body is large and firm, and his teeth and claws are sharp. Besides, he enjoys advantages which are peculiar to him. He is neither afraid of cold nor of heat. He lives indifferently on herbs, flesh, or fish. He inhabits without inconvenience water, land, and ice. He, along with the walrus, alone deserves the epithet of *amphibious.* He alone has the *foramen ovale* of the heart open; and, consequently, he alone can dispense with respiration, the elements of air and water being equally agreeable to him. The otter and beaver are not really amphibious, since air is their proper element; and as they are deprived of this aperture through the septum of the heart, they cannot remain long under water, but are obliged either to leave it, or to raise their heads above it in order to respire.

[As the seals are destined to remain a long time in the water, and as the transmission of the blood through the lungs cannot be performed without respiration, they have the foramen ovale open, as in the fœtus, which never respires. It is an aperture which makes a communication between the right ventricle of the heart and the left, and allows the blood to pass directly from the cava into the aorta, instead of the long winding course of the lungs.—*Hist. de l'Acad. des Sciences.*]

But these great advantages are balanced by imperfections still greater. The seal is a kind of crippled animal. His arms, thighs, and legs, are almost entirely shut up within his body. Nothing appears without except his hands and feet, which are, it is true, divided into five fingers; but these fingers are not separately moveable, being united by a strong membrane; and these extremities are rather fins than hands and feet, a kind of instruments adapted for swimming and not for walking. Besides, the feet are directed backward, like the tail, and cannot support the body of the animal, which when on land is under the necessity of trailing itself like a reptile. This motion must be painful; for his body being unable to bend in the form of an arch, like the serpents, in order to obtain different points of support, and to advance by means of the reaction of the ground, the seal would remain fixed in the same place, were it not for his hands and tail, which he attaches to whatever he can lay hold of, and uses them with such dexterity, that he mounts very quickly upon a high shore, upon a rock, and even upon a board of ice, though slippery and steep. He walks more rapidly than one should imagine, and though wounded he often escapes from the hunters by flight.

[The sea-wolves on the coast of Canada, which some call *sea-calves*, are as large as big dogs. They keep almost perpetually in the water, never removing to any distance from the margin of the sea. These animals rather crawl than walk; for when out of the water they only slide along the sand or mud. The females bring forth their young upon rocks or small islands. They live upon fishes, and are fond of cold countries.—*La Hontan.*

'The seals are as big as calves, the head of them like a dog, therefore called by the Dutch the *sea-hounds.* Under each shoulder grows a long thick fin: these serve them to swim with when in the sea, and are instead of legs to them when on the land, for raising their bodies up on end, by the help of these fins or stumps, and so having their tail parts drawn close under them they rebound as it were, and throw their bodies forward, drawing their hinder parts after them; and then again rising up and springing forward with their fore parts alternately, they lie tumbling thus up and down all the while they are moving on land.'—*Dampier.*

The sea-calves have very sharp teeth, with which they cut a stick as thick as a man's arm. Though they appear to be lame behind, they climb the boards of ice, upon which they sleep. The sea-calves which frequent the coasts are fatter and yield more oil than those that inhabit the ice. We sometimes find numbers of sea-calves upon such high and precipitous boards of ice, that it is astonishing how they should be able to climb them.—*Zorgdrager.*

'I gave several strokes of my sword to a sea calf, which prevented it not from outrunning me; and it plunged into the water, from which I never saw it rise again.—*Recueil des Voyages du Nord.*]

The seals live in society, or at least great numbers of them frequent the same places. The north is their natural climate, though they can live in the temperate zones, and even in warm climates; for we find some of them upon the coasts of almost every European sea, not excluding the Mediterranean. They are likewise seen in the southern seas of Africa and America. But they are infinitely more numerous in the northern seas of Asia, Europe, and America; and they are also very common in Magellan's Straits, the island of Juan Fernandes, &c.

[The sea-calves are frequent in the northern parts of Europe and America, and in the southern parts of Africa, as about the Cape of Good Hope and at the Straits of Magellan: and though I never saw any in the West Indies, but in the bay of Campeachy, at certain islands called the Alceranes, and at others called the Deserts; yet they are over all the American coasts of the South Seas, from Terra del Fuego up to the Equinoctial line;

but to the north of the Equinox again in these seas I never saw any till as far as 21° north lat. Nor did I ever see any in the East Indies.—*Dampier.*

The seals come to the island of Juan Fernandes in the month of September to bring forth their young. They are then so fierce, that instead of retiring from man they advance in order to bite him though armed with a bludgeon. The margin of the sea is sometimes covered with them to the extent of more than half a mile.—*Woods Rodgers.*]

In different climates the species varies in size, colour, and even in figure. We have seen some of these animals alive, and are possessed of several stuffed skins. We have seen one which seemed to differ in the proportions of its body from the common kind; for its neck was shorter, its body longer, and its claws larger. But these differences are not sufficient to constitute a distinct species. The second is the seal of the Mediterranean and southern seas, which we presume to be the *phoca* of the ancients, and a distinct species; for it differs from the others by the quality of its hair, which is flowing and almost black, while that of the common kind is gray and coarse. It differs still more in the form of the teeth and ears; for it has a kind of small external ear, which the other wants; its cutting teeth also terminate in two points, while those of the other are smooth and sharp edged, like those of the dog, wolf, and other quadrupeds. Its arms are likewise placed lower, or more behind. These differences, however, are perhaps only varieties depending on the climate, and not specific differences; especially as in places where the seals abound we find them larger and smaller, thicker, and thinner, and of various colours, according to their sex and age.

It was from a conformity, which at first view might appear slight, joined to some fugitive relations, that we judged this second or little seal to be the phoca of the ancients. We have been assured, that the individual in our possession was brought from India; and it is very probable that it came from the Levant. It was an adult; for it wanted no teeth. Its size was at least a fifth part less than that of the full grown seals in our seas, and two thirds less than those of the frozen sea; for it exceeded not two feet three inches in length, while that described by Mr. Parsons, though not an adult, as it wanted several teeth, was seven feet and a half. Now the characters which the ancients ascribe to their *phoca* correspond not with an animal of such magnitude, but apply to this small seal, which they frequently compare to the beaver and otter, animals that never can be compared with the large seals of the north. There is another relation, which, though false in its object, could never be attributed to our seals, or to those of the northern seas. The ancients, when treating of the *phoca,* tell us, that its hair waves, and from a natural sympathy follows the motions of the sea; that it lies backward when the tide ebbs, and forward when it flows; and that this singular effect continues long after the skin has been separated from the animal. Now this quality could never have been imagined with regard to our seals or those of the north; because the hair of both is short and stiff. But it agrees in some measure with the small seal, whose hair is waving, and much longer and suppler than that of the other kinds. In general seals of the southern have finer and softer hair than those of the northern seas. Besides, Cardan affirms positively, that this quality, which had been considered as fabulous, is found to be real in the Indies. Without giving more faith to Cardan's assertion than it deserves, it at least shows that this quality is peculiar to the Indian seal. Perhaps the appearance, if it exists, is electrical; and both ancients and moderns, being ignorant of the cause, have ascribed the effect to the ebbing and flowing of the sea. But however this matter stands, the reasons already given are sufficient to found a presumption that the small seal is the *phoca* of the ancients. It is likewise probable that it is the same with Rondeletius's *Mediterranean seal,* which, he remarks, has a body proportionally longer and thinner than the seal of the ocean. The large seal, of which Mr. Parsons has given a figure and description, and which was probably brought from the northern seas, seems to be a species distinct from the other two; for though so young as to have hardly any teeth, it was more than double the magnitude of the common kind. M. Klein, as well as Mr. Parsons, have said a great deal concerning this animal in a few words.

[This sea-calf was shewed at Charing-cross, London, in the month of February, 1742. The figures given by Aldrovandus, Johnston, and others, being profiles, lead us into two errors: 1st, They make a cubit in the fore limb, which is not visible in any shape from the surface of the body: and, 2dly, make the posterior parts terminate in two fins, which, on the contrary, are actually webbed feet, like those of water-fowl, consisting of five toes, each having three articulations, and ending with nails of a darkish colour. The nails of the fore paws are very considerable, being like the paws of a mole, contrived for crawling upon land, and partly for swimming, by a narrower web between each toe; but the hinder feet are extensive webs, serving alone to drive or row the creature in the waters. The animal, which was a female, died yesterday morning, *Feb.* 16, and the *viscera* were as follows: the stomachs, intestines, bladder, kidneys, ureters, diaphragm, lungs, great blood-vessels, and *pudenda,* were like those of a cow. The hairs of the whiskers are very long and clear. The spleen was two feet long, four inches broad, and very thin. The liver consisted of six lobes, each hanging as long and as lank as the spleen, with a very small gall-bladder. The heart was long and flabby in its contexture in general, having a large *foramen ovale,* and very great *columnæ carnosæ.*

In the lower stomach were about four pounds weight of flinty pebbles, of which these I have the honour to lay before you are part; they are sharp and angular, as if the animal chose them of that form for cutting the food. The uterus is of the horned kind, each *cornu* being considerably thicker than the body or duct leading to them. The *ovaria* are very large, being granulated on the surface with the *ova*, under a very thin membrane; and the opening into the tubes leading to the *cornua* is a great hole. I have annexed a drawing of this part as well as of the animal itself, which is thought perfectly like the original. The animal is viviparous, and suckles its young by the mamillæ, like quadrupeds, and its flesh is carnous and muscular. This was very young, though seven feet and a half in length, having scarce any teeth, and having four holes regularly placed about the navel.—*Phil. Trans.*]

From what has been remarked, it appears, that there are three distinct species of the seal: the small black seal of India and the Levant, the common seal of our seas, and the large seal of the northern ocean. To the first of which all that the ancients have written concerning the *phoca* must be referred. Aristotle knew this animal; for he tells us, that it is of an ambiguous nature, an intermediate creature between aquatic and terrestrial animals; that it is an imperfect quadruped; that it has no external ears, but only two conspicuous auditory passages, and that it has a forked tongue, paps for suckling, and a small tail, like that of the stag. But he seems to have been deceived when he says that this animal has no gall-bladder. Mr. Parsons indeed acknowledges, that the gall-bladder of the large seal he has described was very small. M. Daubenton, however, found in our seal, which he dissected, that the gall-bladder was proportioned to the size of the liver; and the gentlemen of the academy found a gall-bladder in the seal they describe; but mention not that it was remarkably small.

Aristotle, besides, could have no knowledge of the large seals produced in the frozen sea; because in his time the whole north of Europe and of Asia were entirely unknown. The Greeks, and even the Romans, regarded France and Germany as their north. The Greeks, particularly, knew none of the animals peculiar to these countries. Hence Aristotle, who mentions the *phoca* as a common animal, can mean nothing else than the Mediterranean seal.

These three animals, though different in species, have many common properties, and ought to be regarded as of the same nature. The females bring forth in winter, and place their young upon a bank of sand, a rock, or a small island. They sit on their hind legs, to allow their young to suck; and they continue to nourish them in this manner during twelve or fifteen days, without removing them from the place of their birth. After which the mother carries them to the sea, and learns them to swim and to search for food. When fatigued she places them on her back. As every litter consists only of two or three, her cares are not much divided, and their education is soon completed. Besides, nature has bestowed on these animals uncommon sagacity and sentiment. When assistance is necessary, they understand and mutually aid one another. The young know their mother in the midst of a numerous troop. They distinguish her voice, and when she calls, they never fail to come. We know not the period of gestation; but if we judge of it from that of the growth, the duration of life, and the magnitude of the animal, it must be several months: it is some years before they acquire their full growth, and the duration of their life must be proportionally long. I am even inclined to believe that they live longer than is generally imagined, perhaps above a hundred years; for the cetaceous animals live much longer than the quadrupeds; and as the seal is the intermediate link between both, it ought to partake of the nature of the former, and of course enjoy life longer than the latter.

The voice of the seal has been compared to the barking of a hoarse dog: when young it is clearer, and resembles the mewing of a cat. The young, when carried off from the mother, mew continually, and sometimes die of hunger rather than take the food that is offered to them. The old seals bark at those who strike them, and use every effort to bite and avenge themselves. In general they are not very timid, and even show marks of courage. Instead of being afraid at lightning or thunder, it seems to entertain them. During a tempest, they leave the water, and even the ice, to avoid the shock of the waves; and they come upon the land to amuse themselves with the storm, and to receive the rain, of which they are exceedingly fond. They have naturally a disagreeable smell, which is felt at a great distance when numbers of them are collected in one place. When pursued they frequently void their excrements, which are yellow, and diffuse an abominable odour. They have a great quantity of blood; and as they are likewise loaded with fat, they are heavy and sluggish. They sleep much, and very sound. They love to sleep in the sun, upon boards of ice, and upon rocks; and they may be approached without wakening them. This is the most common mode of seizing them. They are seldom shot, because though the ball enters their head they do not die suddenly, but spring into the water, and the hunter loses them. As they may be approached very near when asleep, or when at a distance from the sea, their motion being slow, they are assaulted with clubs and poles. They are very robust and tenacious of life. 'They die not easily,' a traveller remarks; 'for though mortally wounded, their blood almost entirely exhausted, and their skin taken off, they still 'live; and it is frightful to see them, in this condition, 'weltering in their blood. We killed one which was 'eight feet long. After skinning it, and taking out most 'of the fat, notwithstanding all the blows it had received 'on the head and muzzle, it still endeavoured to bite, 'and even seized a cutlass with nearly as much vigour 'as if it had not been wounded. We afterwards thrust 'a sword across the heart and liver, from which their 'issued as great a quantity of blood as comes from an ox.' —*Recueil des Voyages du Nord, tom. 2. p.* 117.

The hunting of these animals, though not difficult, is very profitable; for the flesh makes tolerable food, and the skin is a good fur: The Americans make a kind of balls of it, which they fill with air, and use as rafts. From their grease an oil is extracted, which is finer and better tasted than that of the porpoise and other cetaceous fishes.

[The second species of sea-wolves *(seals)* is smaller than the first *(walrus)*. They bring forth their young on land, on the islands, upon the sand, upon rocks, &c. The savages make war with these animals. Their flesh is good, and their oil is used as a dainty at all their feasts. These sea-wolves come ashore at all seasons, and never retire far from the land. In fine weather, they are found sleeping or basking in the sun upon the sands, or upon rocks. In some places a band of two or three hundred of them may be seen on the shore. They are easily killed. All the materials for oil are collected about the bladder, into which the savages put it, after being melted. This oil is extremely good, and is employed for frying fish, and other purposes. It is as sweet and well flavoured as olive oil; and, when put into barrels, it leaves neither odour nor dregs.—*Denis.*]

To the three species of seals already mentioned, we may perhaps add a fourth, of which the author of Anson's voyage has given a figure and description under the name of the *sea lion*.

[Leonine seal. The *male* has an arched projecting snout, hanging five or six inches below the lower jaw. The feet are short and dusky, with five toes on each, furnished with nails. The hind feet have the appearance of great laciniated fins. It has large eyes, and great whiskers. The hair on the body is short, and of a dun colour; that on the neck a little longer. The skin is very thick. The length of an old male is twenty feet, and the greatest circumference fifteen.

Female.—Nose blunt, tuberous at the top; nostrils wide; mouth breaking very little into the jaws; two small cutting teeth below, two small, and two larger, above; two canine teeth remote from the preceding; five grinders in each jaw; all the teeth conic; eyes oblique and small; auricles none; fore legs twenty inches long; toes furnished with flat oblong nails; hind parts, instead of legs, divided into two great bifurcated fins; no tail; the whole covered with short rust-coloured hair; length, from nose to the end of the fins, four yards; greatest circumference two yards and a half. —*Pennant.*]

The sea lion abounds on the Magellanic coasts, and at the island of Juan Fernandes in the South Sea. They resemble the seal, which is likewise very common in the same latitudes; but they are much larger. When they have acquired their full growth, they are from eleven to eighteen feet long, and from seven or eight to eleven feet in circumference. They are so fat, that, after piercing the skin, which is an inch thick, there is at least a foot of blubber, before we reach the flesh. One of them will yield five hundred pints of oil. They are, at the same time, very full of blood, which springs with great force when the animal is deeply wounded. Upon cutting the throat of an individual, two hogsheads of blood were collected, beside what remained in the vessels of the body. Their skin is covered with short hair, of a clear tawny colour; but their tail and feet are blackish. Their toes are united by a membrane, which extends not to their extremity, and each of them is terminated by a claw. They differ from the common seals, not only in magnitude, but in other characters. The males have a kind of large crest or trunk, which hangs from the end of the upper jaw to the length of five or six inches. This part is wanting in the females, which, beside their being much smaller, at once distinguishes them from the males. Each male carries about with him a troop of females, and allows no other male to approach. These animals are truly amphibious. They pass the summer in the sea, and the winter upon land. In this last season, the females bring forth, and produce but one or two at a time, which they suckle. A new-born sea lion is as large as a full grown common seal.

During all the time the sea lions are upon land, they feed upon the herbage which grows on the banks of running waters. When not pasturing, they sleep in the mire. They are very indolent; and it is difficult to waken them: but they have the precaution of stationing males as sentinels round the places where they sleep; and these sentinels are said to give warning when danger approaches. Their cries are loud and of various tones. Sometimes they grunt like hogs, and sometimes snort like horses. The males often quarrel about the females, and inflict dreadful wounds with their teeth. The flesh of these animals is tolerable food; the tongue, particularly, is equally good as that of an ox. It is very easy to kill them; for they can neither fly nor defend themselves. They are so unwieldy, that they can hardly move or turn themselves. A person has only to take care not to come too near their teeth, which are very strong, and with which they inflict mortal wounds.

From other observations, compared with the former, and from some conclusions to be deduced from them, it appears that these sea lions, which are found in the southern point of America, appear again, with little variety, on the northern coasts of the same Continent. The large seals of Canada, mentioned by Denis under the denomination of *sea wolves*, and which he distinguishes from the common seals, may be of the same species with the sea lions. Their young, this author remarks, when brought forth, are thicker and longer than the largest hog. Now, it is certain, that the seals of our ocean, though full grown, are never of this size. The Mediterranean seal, or the *phoca* of the ancients, is still less. There remain only the seals described by Parsons, whose magnitude corresponds with those of Denis. Parsons does not mention the sea where this large seal was found. But whether it came from the North of Europe or from America, it might be the same with the sea wolf of Denis, and the sea lion of Anson; because its size is the same, since, though it had not nearly acquired its full growth, it was seven feet long. Besides, the most remarkable difference, next to that of magnitude, between the sea lion and the seal, is a large crest which the male of the former has upon the upper jaw; but the female has no crest. Parsons did not see the male. He described the female only, which had no crest, and perfectly resembled the female sea lion of Anson. To these similarities, Parsons adds another, which is still more remarkable: He tells us, that his seal had the stomachs and intestines of a cow; and, at the same time, the author of Anson's voyages says, that the sea lion feeds upon herbage during the whole summer. Hence it is extremely probable, that the structure of these two animals is the same, or rather that they are the same animals, and very different from the other seals, who have but one stomach, and feed upon fishes.

Woods Rogers had mentioned, before the author of Anson's voyage, these sea lions on the coasts of South America, and describes them a little differently: 'The 'sea lion,' he remarks, 'is a very strange creature, and 'of a prodigious size. I have seen some of them above 'twenty feet long, and could not weigh less than four 'thousand pounds. Others were sixteen feet in length, 'and might weigh about two thousand pounds. The 'quantity of oil they yielded was amazing. The figure 'of their body approaches to that of the sea calf; but 'their skin is thicker than that of an ox. The hair is 'short and coarse, the head disproportionally large, and 'the mouth remarkably big; the eyes are of a monstrous 'size. The muzzle resembles that of a lion, with terrible whiskers, the hairs of which are so stiff that they 'may serve for tooth-picks. About the end of the month 'of June, these animals repair to the island of Juan Fernandes, in order to produce their young, which they 'deposit about a gun-shot from the margin of the sea. 'There they remain till the end of September, without 'moving out of the place, and without taking any 'nourishment; at least, we never saw them eat. I observed some of them continue eight days in the same 'spot, and would not have abandoned it, if we had not 'frighted them.—At the island of Lobos, on the coast of 'Peru, we saw some sea lions, and a great number of 'seals.'

These observations of Woods Rogers, which correspond very well with those of the author of Anson's voyage, seem still farther to prove, that the sea lions feed upon herbage when they are on land; for it is by no means probable, that they pass three months without taking any nourishment, especially when suckling their young. In the collection of voyages to the South Sea, there are many remarks concerning these animals; but neither the facts nor descriptions appear to be exact. For example, it is said, that, in Magellan's straits, there are sea wolves so large, that their skin, when extended, was thirty-six feet wide; which is unquestionably an exaggeration. We are also told, that in the two islands of Port Desire, these animals resemble lions in the anterior part of their body, having the head, neck, and shoulders, garnished with a very long bushy mane. This is still a greater exaggeration; for the sea lions have only a little more hair on the neck than on the rest of the body; but this hair exceeds not an inch in length. It is farther remarked, that some of these animals are more than eighteen feet long; that many of them are only fourteen feet, and that generally they exceed not five. This account would lead us to believe that there are two species, the one much larger than the other; because the author does not inform us whether this difference was owing to the difference of their ages, which, however, was necessary to prevent error. 'These animals,' says Coreal, 'keep their 'mouths always open; two men are hardly able to kill 'one of them with a spear, which is the best weapon to 'use against them. The female suckles four or five 'young, and drives away any other young ones which 'approach her; from this circumstance I concluded 'that the females bring forth four or five at a litter.' This conjecture seems to be well founded; for the seal described by Mr. Parsons, had four paps, situated in such a manner as to form a square, in the centre of which the navel is placed. I thought it proper to collect all the facts relative to these animals, which are very little known. It were to be wished that some sensible traveller would furnish us with a proper description of them, and particularly of their internal parts, as the stomach, intestines, &c.; for, if the testimony of voyagers could be relied on, we should believe that the sea lions belong to the class of ruminating animals; that they have several stomachs; and, consequently, that their species is far removed from that of the seal, or sea calf, which certainly has but one stomach, and ought to be ranked with the carnivorous tribes.

THE WALRUS, MORSE, OR SEA COW.

The arctic walrus, with two great tusks in the upper jaw, pointed downwards; four grinders on both sides, above and below; no cutting teeth; five palmated toes on each foot; a round head; small mouth; very thick lips, covered above and below with pellucid bristles as thick as a straw; small fiery eyes; two small orifices instead of ears; short neck; body thick in the middle, tapering towards the tail; skin thick, wrinkled, with short brownish hairs thinly dispersed; legs short; five toes on each foot, all connected by webs, and small nails on each; the hind feet very broad; each leg loosely articulated; the hind legs generally extend on a line with the body; tail very short; penis long; the length, from nose to tail, sometimes eighteen feet, and ten or twelve round in the thickest part. The tusks have been sometimes found of the weight of twenty pounds each.

The denomination of *sea cow*, under which the walrus is most generally known, has been ill applied; for the animal it denotes has no resemblance to a cow. The name *sea elephant*, which others have given it, is better imagined, because it is founded on a conspicuous character: the walrus, like the elephant, has two large ivory tusks which proceed from the upper jaw; and its head, if it had a trunk, would have a great resemblance to that of the elephant. The walrus not only wants this instrument, which serves the elephant for an arm and hand, but it has not the use of its arms and legs, which, as in the seals, are inclosed within the skin, the hands and feet being alone free. The body is long, swelled before, narrow behind, and every where covered with short hair. The fingers of the hands and feet are enveloped in a membrane, and terminated by sharp short claws. Thick hairs in the form of whiskers surround the mouth. The tongue is furrowed. The walrus has no external ears; so that if we except the two large tusks which change the form of the head, and the want of cutting teeth both above and below, it resembles the seal in every other article: it is only much larger and stronger. The largest seals exceed not seven or eight feet. The walrus is generally twelve; and some of them are sixteen feet long, and eight or nine in circumference. Both animals inhabit the same seas, and are almost always found together. They have many common habits: they live equally in water or on land: they both climb upon boards of ice: they suckle and manage their young in the same manner: they live on the same food, and equally associate in large troops. But the species of the walrus is not so much diversified as that of the seal. Neither does it stray to such distances, but is more attached to its proper climate; for it is seldom seen any where but in the northern seas. Hence the ancients were acquainted with the seal, but had no knowledge of the walrus.

This animal is mentioned by most voyagers who have frequented the northern seas of Asia, Europe, and America.

[We find the tusks of the walrus in the environs of Nova Zembla, and in all the islands, as far as the Oby. They are said to be frequent about Jeniski, and they were seen formerly as far as Pjasida. We again meet with them at Schalaginskoi, and among the Schuktschii, where they are very large. It is probable that these animals are numerous from this place to the river Anadir; for all the tusks sold at Jakutzk are brought from Anadirskoi. The tusks of the walrus are likewise found in Hudson's straits, where they are a Russian ell in length, and as thick as a man's arm. Their ivory is equally good with that of the elephant's tusks.—*Voyage du Nord.*

'At Jakutzk I saw some teeth of the walrus which were a Russian ell and a quarter, and others an ell and a half in length. They are commonly broader than thick, and are about four inches wide at the base. I never heard that in the neighbourhood of Anadirskoi the walrus was hunted or fished to procure its teeth. On the contrary, I was assured, that the inhabitants found these teeth on the low shores, detached from the animal; and, consequently, that there was no occasion for killing the creatures. I have frequently been asked, whether the walrus of Anadirskoi was a different species from that found in the west passage of the frozen sea, because the teeth brought from the east coast are much larger than those which come from the west. It appears that the walrus of Greenland, and that on the west of the frozen sea, have no communication with those found on the east of Kolima, about the point of Schalaginskoi, and still farther, near Anadirskoi. Neither do those of Hudson's bay seem to join those of Tschuktschi. It is universally agreed, however, that the walrus of Anadirskoi differs neither in size nor figure from that of Greenland, &c.'—*Gmelin. Note*—M. Gmelin has not resolved this question, though I think it may be answered in a satisfactory manner. He remarks, that these animals are neither hunted at Anadirskoi nor on the eastern part of the frozen sea; and consequently no teeth are brought thither but those of the creatures who die a natural death; of course, it is not surprising that teeth which have acquired their full growth should be larger than those of the Greenland walrus, which is often killed when young.

'On the coasts of North America we saw sea cows, called also *beasts with the large teeth*, because they have large tusks as long as the half of a man's arm. No ivory can be finer; and they are found on Sable island.'—*Denis.*]

As Zorgdrager appears to speak of the walrus with greater intelligence than any other author, I shall here give a translation of what he has said on this subject, which was communicated to me by the Marquis de Montmirail.

'In Horisont and Klock bays the walrus and seals 'were formerly very numerous; but few of them now 'remain. During the heat of summer both of them 'resort to the neighbouring plains, and are sometimes 'seen in troops of one or two hundred, particularly the 'walrus, who can continue there for several days running, 'till hunger forces him back to the sea. These animals 'have a great resemblance to the seal; but they are 'stronger and larger. Like the seal they have five toes; but 'their claws are shorter, and their head thicker, rounder, 'and stronger. The skin of the walrus, especially about 'the neck, is an inch thick, wrinkled, and covered with 'very short hair of various colours. His upper jaw is 'armed with two tusks of half an ell or an ell in length, 'which are hollow at the root, and grow larger as the 'animal advances in years. The walrus is sometimes 'observed to have but one tusk, having lost the other 'by fighting or by age. This ivory is generally clearer 'than that of the elephant; because it is harder and more 'compact. The mouth of the walrus resembles that of 'an ox, and is garnished above and below with hollow 'pointed hairs, about the thickness of a straw. Above 'the mouth are two nostrils, through which these ani'mals blow the water, like the whale, without, however, 'making much noise. Their eyes are sparkling, red, and 'inflamed during the heat of summer; and as they can'not then endure the impression made by the salt water 'on their eyes, they continue more willingly on the land 'in summer than in any other season.—They are very 'numerous about Spitzbergen.—They are killed on 'land with lances.—They are hunted on account of 'the profit derived from their teeth and grease. Their 'oil is nearly as much esteemed as that of the whale. 'Their teeth are of more value than the whole oil they 'yield. The internal part of the teeth, especially when 'large, the substance of which is harder and more com'pact than that of the smaller ones, is more precious 'than ivory. When a pound of the smaller kind is sold 'for a florin, a pound of the large brings three, four, and 'often five florins. A middle sized tooth weighs three 'pounds, and an ordinary walrus furnishes half a tun 'of oil. Hence the whole animal brings thirty-six florins, 'eighteen for the two teeth, and as much for the oil. '—Formerly vast troops of these animals were found 'on land. But our vessels, which go annually to the 'whale fishery, have so terrified them, that they have 'retired to the most sequestered places; and those who 'remain never venture upon land in troops, but con'tinue in the water, or dispersed among the boards of 'ice.' [The number of these animals must be greatly reduced, or rather most of them have retired to unknown coasts; for we find in the collection of voyages to the north, that in the year 1704, near Cherry island, in the latitude of 65 degrees 45 minutes, the crew of an English vessel fell in with a prodigious number of these creatures, all lying near each other; that out of more than a thousand, of which this troop consisted, the sailors killed only fifteen; but that they found as many teeth as filled a ton—that, on the 13th of July they killed a hundred more, of which they carried off only the teeth—that in 1706 another English crew killed seven or eight hundred in six hours; in 1708 more than nine hundred in seven hours; in 1710 eight hundred in a few days; and that a single man slew forty with a spear.]

'When a walrus is met with upon the ice, or in the 'water, a strong harpoon is darted at him, which not 'unfrequently slips upon the thick hard skin. But when 'pierced the animal is dragged with a cable toward the 'helm of the boat, is slain with a strong spear made for 'the purpose, and afterwards brought to the nearest 'shore, or to a flat board of ice. He is generally hea'vier than an ox. The fishers begin with taking off his 'skin, which being of no value is thrown away. With 'a hatchet they separate the two teeth from the head; 'or, to prevent the teeth from damage, they cut off the 'head, and boil it in a cauldron. The blubber is after'wards cut into long slices, and carried to the ship. '—It is equally difficult to follow the walrus by row'ing as the whale, and the harpoon is often darted 'in vain; because the whale is more easily pierced, and 'the harpoon does not slip so readily.—The walrus 'is often struck three times with a strong sharp spear, 'before his hard thick skin is pierced. It is necessary, 'therefore, to strike him in a place where the skin is 'well stretched. For this reason the fishers aim at the 'eyes of the animal, which obliges it to turn its head, 'and stretch the skin of the throat or breast. Then the 'blow is given in this place, and the spear is quickly 'retracted, to prevent the creature from seizing it with 'his teeth, and wounding his assailant, either with his 'teeth, or even with the spear, which sometimes hap'pens. The attack upon a small board of ice never lasts 'long; because the walrus, whether wounded or not, 'throws himself quickly into the water; and therefore 'attacking him upon land is always preferred. These 'animals are found in unfrequented places only, as in 'the island of Moffen, behind Worland, in the land sur'rounding Horisont and Klock bays, in retired plains, 'and banks of sand, where vessels rarely approach. Even 'those which are there met with, instructed by the per'secutions they have suffered, are so much on their 'guard, that they keep always near the water, to facilitate 'their retreat. This fact I experienced on the large 'bank of sand behind Worland, called *Rif*, where I fell 'in with a troop of thirty or forty. Some of them were 'on the very margin of the water, and others at no 'great distance from it. We stopped some hours with'out landing, in hopes that they would advance farther

' into the plain. But as this stratagem did not succeed,
' we landed with two boats to the right and left of them.
' Almost the whole of them were in the water the mo-
' ment we put our feet on the land; so that our hunting
' was confined to the wounding of a few, which likewise
' instantly darted into the sea.—Before being perse-
' cuted, these animals advanced far upon land; so that, in
' high tides, they were at a great distance from the water;
' and, when the tide ebbed, the distance being increased,
' they were easily assailed.—We marched in front of
' these animals to cut off their retreat from the sea. They
' saw all these preparations without betraying any symp-
' toms of fear; and each hunter often killed one of them
' before it could regain the water. We made a barrier
' of the dead carcases, and left some of our men in am-
' bush to slay those which remained. We sometimes
' killed three or four hundred.—From the prodigious
' quantity of teeth scattered over the ground, it is ob-
' vious that these animals must have formerly been very
' numerous.—When wounded, they become furious,
' striking from one side to the other with their teeth.
' They break the arms, or drive them out of the hands
' of their assailants; and at last, burning with rage,
' they place their heads between their paws, or fins, and
' allow themselves to tumble into the sea.—When
' very numerous, they grow so audacious, that, in order
' to secure one another, they surround the boats, and
' endeavour to overset them, by striking or piercing the
' planks with their teeth.—In fine, this elephant of
' the sea, before he became acquainted with men, was
' afraid of no enemy, because he had learned to conquer
' the rapacious Greenland bear, which may be ranked
' among the number of sea robbers.'

By adding to Zorgdrager's remarks those which are to be found in the Collection of Voyages to the North, and others that are scattered in different relations, we shall have a pretty complete history of this animal.

[The sea horse *(walrus)* resembles the sea calf *(seal)*, except that he is much larger; for he is of the size of an ox. His paws both before and behind, like those of the sea calf, have five toes; but the claws are shorter. His head is likewise larger, rounder, and harder, than that of the sea calf. His skin, especially about the neck, is fully an inch thick. Some of them are covered with mouse-coloured hair, and others have very little hair. They are generally so infested with scabs and excoriations, that one should imagine they had been flayed, especially about the joints, where the skin is much wrinkled. In the upper jaw they have two large tusks, which sometimes exceed two feet in length. The young ones have no tusks; but they grow as the animals advance in years.—These tusks are more esteemed than the finest ivory; they are solid within, except near the roots. The opening of their mouth is as large as that of an ox; and, both above and below the lips, there are several bristles, which are hollow within, and as thick as a straw. Above the whiskers, there are semicircular nostrils, through which they throw out water, like the whales, but with much less noise. Their eyes are situated high above the nose, and they are as red as blood. Their ears are not far from their eyes, and resemble those of the seal. Their tongue is at least as large as that of an ox.—Their neck is so thick, that it is with difficulty they can turn their head, which obliges them to move their eyes almost continually. Their tail is short, like that of the seal. Their grease is not so easily removed as in the seals, because it is interlarded with flesh. Their penis consists of a hard bone, about two feet long, which tapers toward the point, and is a little bended in the middle. Very near the belly, the penis is flat; but, beyond that, it is round, and covered with sinews.—These animals, it is probable, live upon herbs and fishes; their dung resembles that of a horse. When they dive, like the seals, they plunge their head first into the water. They sleep and snore, not only on the ice, but in the water; so that they frequently have the appearance of being dead. They are bold and furious, and defend each other to the last drop of their blood.—They exert every effort to relieve those which are taken. They assault the boat on all sides, biting and bellowing in a hideous manner; and, if by means of their number, they oblige the enemy to fly, they pursue the boat till they lose sight of it.—They are hunted solely for the sake of their teeth; but, out of a hundred, perhaps not above one tooth is found to be good; because some of them are too young, and others have spoiled teeth.—*Recueil des Voyages du Nord.*]

The species of walrus seems to have formerly been much more diffused than at present. They were found in the seas of the temperate zones, in the gulf of Canada, upon the coasts of Arcadia, &c. But they are now confined to the seas of the frozen zones, and even there they are very scarce in places which are much frequented. There are few of them in the frozen seas of Europe, and still fewer in those of Greenland, Davis's straits, and other parts of North America; because, on account of the whale fishery, they have been long disturbed and hunted. From the end of the sixteenth century, the inhabitants of St. Malo went to the Ramée islands in quest of the walruses, which were then very numerous. It is not a hundred years since the merchants of Port-Royal in Canada sent barks to Cape Sable and Cape Fourchu to hunt these animals, which have some time ago forsaken these latitudes, as well as those of the European seas; for they are now found in considerable numbers only in the frozen sea of Asia, from the mouth of the Oby to the most eastern point of that Continent, the coasts of which are very little frequented. They are rarely seen in the temperate seas. The species found under the Torrid Zone, and in the Indian ocean, is very different from our northern walrus. The latter seem to dread either the heat or the saltness of southern seas; and, as they have never traversed these seas, they are not found toward the South Pole, though we see there the large and small seals of the North, which are even more numerous than in our Arctic regions.

The walrus, however, can live at least some time in a temperate climate. Edward Worst tells us, that he saw one of these animals alive in England, which was three months old; that it was put into water, for a short time only, each day; and that it crawled upon the ground.—He does not say that it was incommoded by the heat of the air, but, on the contrary, that, when touched, it had the aspect of a furious and robust animal, and that it respired strongly through the nose. This young walrus was of the size of a calf, and had a great resemblance to the seal. Its head was round, its eyes large, and its nostrils flat and black, which it opened and shut at pleasure. It had no ears, but only two auditory passages. The opening of the mouth was not large, and the upper jaw was garnished with whiskers, consisting of coarse, thick, cartilaginous hairs. The under jaw was triangular, the tongue thick and short, and the inside of the mouth fortified on each side with flat teeth. Both the fore and hind feet were broad, and the hind part of the body was perfectly similar to that of the seal. This hind part crawled rather than walked. The fore feet turned forward, and those behind backward. They were all divided into five toes, covered with a strong membrane. The skin was thick, hard, and covered with short delicate hair, of an ash-colour. This animal grunted like a wild boar, and sometimes cried with a strong, deep voice. It was brought from Nova Zembla, and had not yet acquired the two tusks; but on the upper jaw, the knobs from which they were to spring were visible. It was fed with boiled oats or millet, which it rather slowly sucked than eat. It sprung with fury at its master, and made a growling noise. It followed him, however, when he presented it with victuals.

This account, which gives a tolerable just idea of the walrus, shows, at the same time, that it can live in a temperate climate. Nevertheless, it does not appear that it could endure great heat, or has ever frequented the southern seas, so as to pass from the one pole to the other. Several voyagers mention sea cows which they have seen in India, but these belong to a different species; that of the walrus is always easily distinguished by its long tusks, which no other animal has except the elephant. This production is an effect rarely exhibited in nature; for, of all the terrestrial and amphibious animals, the elephant and walrus, in which alone it appears, are solitary species, and constitute distinct and undivided genera.

We are assured that the walruses couple not in the manner of quadrupeds, but backward. The male, like the whales, has a large bone in the penis. The females bring forth in winter upon the land, or upon boards of ice, and generally produce but one young at a time, which, when born, is as large as a hog of an year old. We are ignorant of the period of gestation; but to judge of it from that of the growth, as well as the magnitude of the animal, it ought to be more than nine months. The walruses cannot remain always in the water, but are obliged to come upon land, either to suckle their young, or for other purposes. When under the necessity of climbing steep shores, or boards of ice, they use their teeth and hands as hooks to drag along the unwieldy masses of their bodies. It is alledged, that they feed upon shell fishes which adhere to the bottom of the sea, and that they use their tusks to disengage them. Others affirm, that they live upon a certain sea-herb with broad leaves, and that they neither eat flesh nor fish. But I believe none of these assertions to be true. The walrus, it is probable, lives upon prey, like the seal, and particularly on herrings and small fishes; for he eats none upon land, which obliges him to return to the sea in quest of food.

THE INDIAN WALRUS, OR DUGON.

Indian walrus, with two short canine teeth, or tusks placed in the upper jaw, pretty close to each other. In the upper jaw are four grinders on each side; in the lower, three on each side.

Dugon, or *dugung*, the name of this animal in the isle of Lethy or Leyte, one of the Philippine islands, where, according to Christ. Barchewick, it is also called *ikan* and *manate*. This last denomination would indicate that the *dugung* is a *manati* or *lamentin*. But this author, in his description, tells us, that the dugung has two tusks of an inch thick and a span long. This character cannot apply to the manati, but agrees very well with the animal under consideration, of which we have a head.

The dugon is an animal of the African and East Indian seas. We have seen two heads of it, which had a greater resemblance to the head of the walrus than to that of any other animal. Its head is deformed nearly in the same manner by the depth of the sockets, from which the two tusks in the upper jaw spring. They are half a foot long, and are rather large cutting teeth than tusks. They extend not directly out of the mouth, like those of the walrus; but are much shorter and more slender. Besides, they are situated in the fore part of the jaw, and very near each other, like cutting teeth. But between the tusks of the walrus there is a considerable interval; and they are not situated at the point, but at the side of the upper jaw. The grinders of the dugon differ likewise in number, position, and figure, from those of the walrus. From all which we must conclude, that the dugon is a distinct species. Several voyagers have confounded it with the sea lion. Innigo de Biervillas says, that a sea lion was killed at the Cape of Good Hope, which was ten feet long and four thick. Its head resembled that of a calf of one year old. Its eyes were hideous, and its ears short; and it had a bristly beard, broad feet, and legs so short that its belly touched the ground. He adds, that it had two tusks which issued half a foot out of the mouth. This last character corresponds not with the sea lion, which has no tusks, but teeth like those of the seal. From this circumstance I concluded, that it was not a sea lion, but the animal to which we have given the name of *dugon*. Other travellers seem to have pointed it out under the denomination of the *sea bear*. Spilberg and Mandelslo relate, 'that at the island of St. Elizabeth, on the African 'coast, there are animals which should rather be called '*sea bears* than sea wolves; because, by their hair, their 'colour, and their head, they have a greater resemblance 'to the bear, only the muzzle is sharper; that they 'resemble the bear still more in their manner of moving, except in the movement of the hind legs, which 'are only trailed; that these amphibious creatures have 'a terrible aspect, fly not from man, and bite with such 'force as to break the shaft of a javelin; and that, 'though denied the use of their hind legs, they fail not 'to run with such swiftness that it is difficult for a man 'to overtake them.' Guat tells us, 'That he saw, at the 'Cape of Good Hope, a sea cow of a reddish colour. It 'had a thick round body, large eyes, long tusks, and a 'muzzle a little turned up. He adds, that he was 'assured by a mariner, that this animal, of which we 'could see the fore part only, as it was in the water, had 'feet.' This sea cow of Guat, the sea bear of Spilberg, and the sea lion of Biervillas, appear to be the same animal with the dugon, whose head was sent to us from the isle of France, and which consequently exists in the southern seas, from the Cape of Good Hope to the Philippine islands. Besides, we cannot be certain that this animal, which has some resemblance to the walrus in the head and tusks, has four feet. We only presume from analogy, and the testimony of travellers, that it has these members. But as the analogy is not very great, and the testimony of travellers not sufficiently explicit, we shall suspend our judgment on this subject till we receive better information.

['I could see from my house, which was situated on a rock in the island of Lethy, the turtles at some fathoms deep in the water. I one day saw two large *dugungs* or *sea cows*, which approached near the rock. I instantly informed my fisher, to whom I showed the two animals, which were moving about and eating a green moss that grows on the shore. He ran for his companions, who soon brought a boat to the place. During this time the male came in quest of the female, and being unwilling to leave her allowed himself to be slain also. Each of these prodigious fishes was more than six ells long. The male was a little larger than the female. Their heads resembled that of an ox. *They had two large teeth, a span in length and an inch thick*, which protruded out of the jaw, like those of the wild bear. These teeth were as white as the finest ivory. The female had two breasts, like a woman, and the male organs of generation resembled those of a man. The intestines were like those of a cow, and the flesh had nearly the same taste.—*Christ. Barchewick. Note*—This description corresponds very well with that of the manati, except the teeth. The manati has neither tusks nor cutting teeth; for which reason I conjecture that this dugung was not the manati but the animal under consideration.]

THE MANATI.

The manati has pinniform fore legs; hind parts ending in a tail horizontally flat. These animals are of an enormous size; some of them are twenty-eight feet long and eight thousand pounds in weight. The head, in proportion to the bulk of the animal, is small, oblong, and almost square. The nostrils are filled with short bristles. The gape, or *rictus*, is small. The lips are double. Near the junction of the two jaws the mouth is full of white tubular bristles, which serve the same use as the laminæ of whales, to prevent the food from running out with the water. The lips are also full of bristles, which serve instead of teeth to cut the strong roots of the sea plants, which, floating ashore, are a sign of the vicinity of these animals. In the mouth are no teeth, only two flat white bones, one in each jaw, one above, another below, with undulated surfaces, which serve instead of grinders. The eyes are extremely small, not larger than those of a sheep. The iris is black. It is destitute of ears, having only two orifices so small that a quill will scarce enter them. The tongue is pointed, and but small. The neck is thick, and its junction with the head scarce distinguishable; and the last always hangs down. The circumference of the body near the shoulders is twelve feet, about the belly twenty, near the tail only four feet eight; the head thirty-one inches; the neck near seven feet: and from these measurements may be collected the deformity of this animal. Near the shoulders are two feet, or rather fins, which are only two feet two inches long, and have neither fingers nor nails; beneath they are concave, and covered with hard bristles. The tail is thick, strong, and horizontal, ending in a stiff black fin, and like the substance of whalebone, and much split in the fore part; the end slightly divided.

The skin is very thick, black, and full of inequalities, like the bark of oak, and so hard as scarce to be cut with an ax, and has no hair on it. Beneath the skin is a thick blubber, which tastes like oil of almonds. The flesh is coarser than beef, and will not soon putrify. The young ones taste like veal. The skin is used for shoes, and for covering the sides of boats.

In the animal kingdom the terrestrial tribes commence where the fishes terminate. The manati, which is neither a quadruped nor a whale, retains the two fore feet, or rather hands, of the former. But the hind legs, which in the seal and walrus are almost entirely included within the body, and very much contracted, are totally obliterated in the manati. Instead of two short feet and a still shorter tail, which the walrus carries in a horizontal direction, the manati has only a large tail, which spreads out like a fan, in the same direction; so that at first sight the tail of the former seems to be divided into three, and that in the latter these three parts appear to be united into one. But from a more attentive observation, and particularly from dissection, it appears, that no such union takes place; that there is not a vestige of thigh-bones and legs; and that the bones which compose the tail of the manati are simple vertebræ, similar to those of the cetaceous animals, who have no feet. Hence those animals are cetaceous by the hind part of their bodies, and are only allied to the quadrupeds by the two fore feet or hands on each side of the breast. Oviedo seems to be the first author who has given a kind of history and description of the manati: 'This 'animal,' he remarks, 'is pretty frequent on the coasts 'of St. Domingo. He is very large, and of a deformed 'figure, with a head thicker than that of an ox, small 'eyes, and two feet or hands near the head, which serve 'him for swimming. He has no scales, but is covered 'with a very thick skin. He is a very gentle creature. 'He rises on the waves and eats such herbage on the 'shore as he can reach without coming out of the water. 'He generally swims on the surface. In order to seize 'him the people endeavour to approach him with a boat, 'and then dart at him a large arrow, fixed to a very long 'rope. As soon as he feels himself wounded he runs 'off with the arrow and rope, to the extremity of which 'a large piece of cork or wood is tied, to serve as a 'buoy, that they may discover his route. When the 'animal is exhausted by the wound and loss of blood, 'he approaches the land. They then lay hold of the 'end of the rope, and coil it up, till a few fathoms only 'remain. By the aid of the waves he is gradually brought 'to land, or he is killed in the water with spears. His 'weight is so great that a carriage drawn with two oxen 'is necessary to transport him. His flesh is excellent, 'and when fresh is preferred to beef or fish. When cut 'into pieces and pickled, it in time acquires the taste of 'the tunny fish, and in this state it is most highly 'relished. Some of these animals are more than fifteen 'feet long by six in thickness. The hind part of the body 'is much thinner, and tapers toward the tail, which 'again spreads out at the extremity. As the Spaniards 'call the fore feet of all quadrupeds *hands*, and as this 'animal has only two fore feet, they have denominated 'the *manati*, or the *animal with hands*. He has no external ears, but two apertures only, through which he 'hears. On his skin there are only a few scattered 'hairs; it is of an ash-colour, and an inch thick. Soles 'of shoes, belts, &c. are made of it. The female has 'two paps on her breast, and generally brings forth two 'young, which she suckles.' All these facts related by Oviedo are true; and it is singular, that Cieca and several subsequent writers should affirm, that the manati comes often out of the water to pasture on the land. They have been led into this notion from the analogy of the walrus and seals, which frequently quit the water and continue for some time on the land. But it is certain that the manati never leaves the water, and that he prefers fresh water to salt.

Clusius measured the skin of one of these animals, and found it to be sixteen feet and a half long, and seven feet and a half broad; the two feet or hands were large, and armed with short claws. Gomara assures us, that he sometimes found them of twenty feet in length; and adds, that they frequent the rivers as well as the sea. He relates, that a young manati was reared in a lake in the island of St. Domingo during twenty-six years; that he was so gentle and tame that he took peaceably the food which was presented to him; that he knew his name, and when called upon came out of the water, and crawled to the house to receive his victuals; that he seemed to be pleased with the human voice and the chanting of children; that he had no fear; that he allowed the boys to sit on his back, and carried them from one end of the lake to the other, without plunging them into the water, or doing them any injury. This relation cannot be true in all its circumstances; it seems to be accommodated to the fable of the ancients concerning the dolphin; for the manati is unable to crawl on the ground.

Herrera says very little on this subject; he only assures us, that though very large the manati swims easily, makes no noise in the water, and dives when he hears any distant sound.

Hernandes, who gives two figures of the manati, the one in profile and the other in front, hardly adds any thing to what has been said by former Spanish authors. He only remarks, that both the Atlantic and Pacific oceans, as well as the lakes, produce a deformed animal, called *Manati*, the description of which he copies almost entirely from Oviedo; and then adds, that the hands of this animal have five nails, like those of a man; that it has a large navel and anus; that the vulva resembles that of a woman: that the penis is like that of a horse; that the flesh and grease are similar to those of a fat hog; that the ribs and viscera resemble those of a bull; that they couple on land, the female lying on her back; and that they produce but one young, which is of a monstrous size the moment it is brought forth. The copulation of these animals cannot take place on land, because they are unable to walk, but it is performed in shallow water. Binet remarks, that the manati is of the size of an ox, and as round as a ton; that he has a small head, and very small tail; that his skin is as coarse and thick as that of the elephant; that some of them are so large as to yield more than six hundred pounds of excellent meat; that his grease is as mild as butter; that he delights in the mouths of rivers, where he browses the herbs which grow on the banks; that, in certain places, about ten or twelve leagues from Cayenne, they are so numerous, that a vessel may be filled with them in one day, by expert harpooneers. Father Tertre, who gives a long account of the fishing of the manati, agrees almost in every article with the authors we have quoted. He remarks, however, that this animal has only four toes and four claws on each hand; and adds, that he feeds upon a small sea herb, which he browses in the same manner as an ox; and that, after being satiated with his food, he searches for the rivers and fresh waters, where he browses twice a day; that, when his belly is full, he sleeps with his muzzle half out of the water, which makes him observable at a distance; that the female brings forth two young, which follow her every where; and that, when the mother is taken, we are certain likewise of having the young, who never depart from her, even when dead, but go perpetually round the vessel which carries her. This last fact appears to be very suspicious; It is contradicted by other voyagers, who assure us that the manati produces but one at a time. As all large quadrupeds, and the whale tribes, produce one young only, analogy alone should prevent us from believing that the manati always brings forth two. Oexmelin remarks, that the tail of the manati is placed horizontally, like that of the cetaceous animals, and not vertically, like that of other fishes; that it has no fore teeth, but only a kind of callosity as hard as a bone, with which it cuts the herbage; that it has thirty-two grinders; that it does not see well, on account of the smallness of its eyes, which secrete very little humour, and have no iris; that its brain is small; that, to supply the defect of good eyes, it has an excellent ear; that it has no tongue; that the organs of generation resemble those of man and woman more than any other animal; that the milk of the females, which he had tasted, is very good; that they produce but a single young one, which they embrace and carry with their hands; that the mother suckles it during a whole year, after which it is in a condition to eat herbage, and provide for its own safety; that, from the neck to the tail, this animal has fifty-two vertebræ; that it feeds like the turtle, but can neither walk nor crawl on the ground. All these facts are pretty exact, and even that of the fifty-two vertebræ; for M. Daubenton, in the fœtus which he dissected, found twenty-eight vertebræ in the tail, sixteen in the back, and six, or rather seven, in the neck. This voyager is only deceived with regard to the tongue, which is not wanting in the manati. It is indeed fixed, almost to its extremity, to the under jaw. In the voyage to the American islands, we find a very good description of the manati, and the manner in which it is harpooned. The principal facts, mentioned by this author, correspond with those already quoted. But he remarks, 'That, since the coasts have been inhabited, this animal has become exceedingly rare in the Antilles; and that the one he saw and measured was fourteen feet nine inches from the muzzle to the origin of the tail. The whole body was round. The head was thick, and the mouth large, with great lips, and some coarse hairs about them. The eyes were very small in proportion to the head; and the ears were only two small apertures. The neck is very thick and short; and, were it not for a small movement which makes it wrinkle, it would be impossible to distinguish the head from the body. Some authors pretend,' he adds, 'that this animal uses its two hands or fins for dragging itself along the ground. I made particular inquiry concerning this fact. But no person had ever seen the animal on land; and it is impossible that it should either walk or crawl, the fore feet, or hands, serving only to hold its young when sucking. The female has two paps which I measured, and found each of them to be seven inches in diameter, by about four of elevation. The teat was an inch thick. The body was eight feet two inches in circumference. The tail was like a large pallet, nineteen inches in length, fifteen inches broad at the widest part, and about three inches thick at the extremity. The skin of the back was double the thickness of an ox's hide, but much thinner on the belly. It is of a brown slate colour, and of a coarse grain, with thick and pretty long hairs of the same colour, thinly scattered over the body. This manati weighed about eight hundred pounds. Along with the mother, the young one was taken, which was nearly three feet long. A part of the tail was roasted on a spit, and we found it to be as good and delicate as veal. The herb upon which these animals feed is from eight to ten inches long, narrow, pointed, tender, and of a beautiful green colour. In some places, this herb is so abundant that the bottom of the sea has the appearance of a meadow. The turtles likewise feed upon it,' &c. Father Magnin de Fribourg, says, that the manati eats such grass as he can reach without coming out of the water.—That its eyes are about the size of a filberd; that its ears are so narrow as hardly to admit a probe; that, within the ears, there are two small perforated bones; that the Indians hang these bones to their necks as a trinket.—Its cry resembles the lowing of a cow.

Father Gumilla relates, that there are immense numbers of manati in the great lakes of the Oronoko: 'Each of these animals,' says he, 'weighs from six to seven hundred pounds. They feed upon herbs. Their eyes are very small, and the auditory passages still smaller. When the river is low, they come to pasture on its margin. The female always brings forth two young, which she carries at her paps, and holds them so firm with her two hands, that they never separate, whatever movement she makes. The young, when new-born, weigh each of them thirty pounds. The milk of the female is very thick. Below the skin, which is much thicker than that of an ox, we find four strata, or layers; two of them consist of fat, and the other two of very tender savoury flesh, which, when roasted, has the flavour of pork and the taste of veal. These animals, when rain is about to fall, spring out of the water to a considerable height.' Both Gumilla and Tertre seem to be deceived, when they assert that the females produce two young at a time; for it is almost certain, as formerly remarked, that they bring forth one only.

In fine, M. de la Condamine, who obligingly communicated to me a drawing of the manati, made by himself on the river of the Amazons, gives a more perfect account of the manners of this animal than any other author. 'Its flesh and fat,' he remarks, 'are analogous to those of veal: Father Acuna renders the resemblance still more complete, by bestowing horns on it which nature never provided. It is not, properly speaking, amphibious; for it cannot go entirely out of the water, having only, near the head, two flat fins, in the form of wings, about sixteen inches long, which serve it for arms and hands; it advances its head only out of the water, in order to reach the grass upon the shore. The one of which I drew a figure was a female. Its length was seven feet and a half, and its greatest width two feet. I have since seen them much larger. The eyes of this animal have no proportion to the size of its body; they are round, and only three lines in diameter. The auditory passages are still smaller, and appear like pin holes. The manati is not peculiar to the river of the Amazons, but is equally common in the Oronoko. It is also found, though not so frequently, in the Oyapoc, and in several other rivers in the neighbourhood of Cayenne, and on the coasts of Guiana, and probably elsewhere. This is the same animal which was formerly called *manati*, and now *lamantin*, at Cayenne, and in our American islands; but I believe the species is somewhat different. They are never met with in the high seas, and are even rare in the mouths of rivers. But they are found at more than a thousand leagues from the sea, in most of the large rivers which fall into that of the Amazons, as in the Guallaga, the Pastaca, &c. In ascending the river of the Amazons, they are stopped by the Pongo, (cataract) of Borja, above which they never appear.'

I have now given a concise account of all that is known concerning the manati. It were to be wished that some of the inhabitants of Cayenne, among whom there are several persons well acquainted with natural history, would examine this animal, and give us a description of its internal parts, particularly those of respiration, of digestion, and of generation. It appears, but we are by no means certain, that there is a large bone in the penis, and a foramen ovale in the heart; that the lungs are singularly constructed, and that it has several stomachs, as in the ruminating animals.

Besides, the species of the manati is not confined to the seas and rivers of the new world, but seems likewise to exist on the coasts and in the rivers of Africa. M. Adanson saw manatis in Senegal, from which he brought one of their heads and gave it to me; and, at the same time, he obliged me with a description of this animal, which he made on the spot, and which I here insert in his own words. 'I saw many of these animals. The largest exceeded not eight feet long, and weighed about eight hundred pounds. A female of five feet three inches in length, weighed only a hundred and ninety-four pounds. They are of a blackish ash-colour. There are hairs thinly scattered over the whole body, in the form of bristles, and are nine lines long. The head is conical and of a middling size, in proportion to that of the body. The eyes are round and very small. The iris is of a deep blue colour, and the pupil black. The muzzle is almost cylindrical; the two jaws are nearly of an equal size, and the lips are thick and fleshy. It has no teeth but grinders in either jaw. The tongue is of an oval form, and attached, almost as far as the point, to the under jaw. It is singular, that almost all authors and travellers have given ears to this animal. I could not discover, in any of them, a hole sufficient even to admit a small probe.' [It is certain, however, that this animal has external auditory passages. M. de la Condamine informed me, that he had seen and measured them, and that they exceeded not half a line in diameter. As the manati has the power of contracting or shutting them, it is probable that they had escaped the observation of M. Adanson, especially as these passages are very small, even when the animal keeps them open.] 'The manati has two arms or fins, situated at the origin of the head, which is not distinguishable from the trunk by any kind of neck, or by shoulders that are perceptible. These arms are nearly cylindrical, and consist of three principal articulations; the anterior one forms a kind of flat hand, in which the toes are only to be distinguished by four claws of a shining reddish brown colour. The tail is horizontal, like that of the whale; and it has the figure of a baker's shovel. The female has two paps, rather elliptic than 'round, and situated near the pits of the arms. The 'skin is half an inch thick on the belly, nine lines on 'the back, and an inch and a half on the head. The fat 'is white, and two or three inches thick. The flesh is 'of a pale red colour, and more delicate than veal. The 'Jalofe Negroes call this animal *lereou*. It lives upon 'herbage, and is found in the mouth of the river 'Niger.'

From this description, it is obvious, that the manati of Senegal differs not from that of Cayenne; and from a comparison made by M. Daubenton of the head of a Senegal manati with that of a fœtus of the Cayenne lamantin, he presumes that they are of the same species. The testimonies of travellers correspond with our opinion: that of Dampier, in particular, is positive, and his remarks merit insertion: 'While we lay here our Muskito men went in their canoe, and struck us some manatee, or sea cow. Besides this Blewfield's river I 'have seen of the manatee in the bay of Campeachy, on 'the coasts of Bocca del Drago, and Bocco del Toro, in 'the river of Darien, and among the South Keys, or 'little islands of Cuba. I have heard of their being 'found on the north of Jamaica a few, and in the rivers 'of Surinam in great multitudes, which is a very low 'land. I have seen of them also at Mindanea, one of the 'Philippine islands, and on the coast of New Holland. 'The manatee delights to live in brackish water; and 'they are common in creeks and rivers near the sea. It 'is for this reason, possibly, they are not seen in the 'South seas, that ever I could observe, where the coast 'is generally a bold shore, that is, high land, and deep 'water close home by it, with a high sea or great surges, 'except in the bay of Panama; yet even there is no 'manatee. Whereas the West Indies, being, as it were, 'one great bay composed of many smaller, are mostly 'low land and shoal water, and afford proper pasture, 'as I may say, for the manatee. Sometimes we find 'them in salt water, sometimes in fresh, but never far 'at sea. And those that live in the sea at such places 'where there is no river nor creek fit for them to enter, 'yet do commonly come once or twice in twenty-four 'hours to the mouth of any fresh water river that is near 'their place of abode. They live on grass seven or eight 'inches long, and of a narrow blade, which grows in the 'sea in many places, especially among islands near the 'main. They never come ashore, nor into shallower 'water than where they can swim.'

[Oexmelin relates, that there are lamantins on the coasts of Africa, and that they are more frequent on the Senegal coast than in the river Gambia.—*Hist. des Avanturiers.*

Guat assures us, that he saw many of these animals off the island of Rodrigue. The head of the lamantin of this island, he remarks, resembles that of a hog, except that the snout is not so sharp. The large lamantins are about twenty feet in length. This animal has warm blood, a coarse, hard, blackish skin, with some thinly scattered hairs on it, small eyes, and two holes, which it opens and shuts, and may be properly called its *ears*. As it often retracts its tongue, which is not large, several authors have imagined that it had none. It has grinders but no cutting teeth; and its gums are sufficiently hard to enable it to browse herbage. I never saw above one young along with the females, which inclines me to think that they bring forth one only at a time. We sometimes found three or four hundred of these animals together. They feed upon a kind of herb which grows in the bottom of the sea. They were so gentle that we often felt them, in order to select the fattest. We passed a rope under their tail to pull them out of the water. We never seized the largest, because they would have cost us too much labour: besides, their flesh is not so delicate as that of the young. We never observed this animal on land, where I suspect it could not crawl; and I believe that it is not amphibious.—*Voyage de la Guat.*]

OF MULES.

We shall retain the name of *mule* to the animal produced by the jack-ass and mare; and to that procreated between the horse and she-ass we shall give the denomination of *bardeau*. The differences which subsist between these two mongrel animals have never hitherto been marked by any author. These differences, however, afford the most certain criterion for distinguishing the relative influence of males and females in the product of generation. A comparison of these two mules, and other mongrels proceeding from a mixture of different species, will give us more precise ideas concerning this relative influence than could be obtained by simply comparing two individuals of the same species.

The bardeau is much smaller than the mule, and seems to preserve the dimensions of its mother, the she-ass; and the mule retains the dimensions of the mare. Hence, in mixed species the size of the body appears to depend more upon the mother than the father. Now these two animals differ in figure. The neck of the bardeau is thinner, the back sharper, and the crupper more pointed; while the forehead of the mule is better shaped, the neck more beautiful, the sides rounder, and the crupper more plump. Hence both of these animals retain more of the mother than of the father, not only in magnitude but in figure of body. This remark, however, does not apply to the head, limbs, and tail. The head of the bardeau is longer, and not so thick in proportion as that of the ass; and the head of the mule is shorter and thicker than that of the horse. Hence, in the figure and dimensions of the head, they have a greater resemblance to the father than to the mother. The tail of the bardeau is garnished with hair nearly in the same manner as that of the horse; and the tail of the mule is almost naked, like that of the ass. In this extreme part of the body, therefore, the similarity to the father predominates. The ears of the mule are longer than those of the horse; and the ears of the bardeau are shorter than those of the ass. The limbs of the mule are hard and limber, like those of the horse; and the limbs of the bardeau are more fleshy. Hence these two animals, in the form of the head, limbs, and other extremities of the body, have a greater resemblance to the father than to the mother.

In the years 1751 and 1752 I made two he-goats copulate with several ewes, and I obtained nine mules, seven males and two females. Struck with this difference between the number of males and females, I endeavoured to discover whether the number of male mules, produced by the ass and mare, predominated in the same proportion. The information I received did not ascertain this point; but I learned that the number of male mules always exceeded that of the females. The Marquis de Spontin Beaufort made a dog intermix with a she-wolf, and procured four mules, three of which were males. In fine, having made enquiries concerning mules which were more easily obtained, I learned, that the number of males greatly exceeded that of the females. In the article *Canary-birds,* I remarked, that of nine young produced between a goldfinch and a Canary bird there were only three females. These are the only certain facts I could collect on this subject, which merits more attention than it has yet received; for the mysteries of generation by the concourse of different species, and the ascertaining of the proportional effective powers of males and females in every kind of reproduction, can alone be developed by an assemblage of similar facts.

[What is related by different authors concerning the jumars appears to be very suspicious. The Sieur Leger, in his history of the Vaudois, tells us, 'That in the valleys of Piedmont there are mongrel animals, called '*jumars;* that when engendered by a bull and a mare, 'they are denominated *baf* or *buf,* and when produced 'by a bull and she-ass, they receive the appellation of '*bif;* that these jumars have no horns, and are of the 'size of mules; that they are very swift; that he 'mounted one of them on the 30th day of September, 'and performed in a single day a journey of eighteen 'leagues; or fifty-four Italian miles; and that they 'were surer and more easy than a horse.'

From an assertion of this kind we would be led to believe, that these jumars, produced by the bull and the mare and she-ass, either exist, or did formerly exist; yet I have never been able to discover any confirmation of these facts.

Dr. Shaw, in his history of Algiers, says, 'To the 'mule we may join the *kumrah,* as the Algerines call a 'little serviceable beast of burden, begot betwixt an ass 'and a cow. That which I saw at Algiers (where it 'was not looked upon as a rarity,) was single hoofed, 'like the ass, but distinguished from it by having a 'sleeker skin, with the tail and the head (though without horns) in fashion of the dam's.' Dr. Shaw is an author who deserves credit. However, having consulted several persons who had been in Barbary, and particularly the Chevalier James Bruce, they all assured me, that they had no knowledge of these animals engendered by an ass and a cow.]

Of my nine mules produced by the he-goat and the ewes the first was brought forth on the 15th day of April. When examined three days after birth, and compared with lambs of the same age, it differed from them in the following particulars: the ears, upper part of the head, as well as the distance between the eyes, were larger. It had besides a band of whitish gray hair from the nap of the neck to the extremity of the tail. The four legs, the superior part of the neck, the breast, and belly, were covered with the same white coarse hair. There was a small quantity of wool upon the flanks only; and even this short curled wool was mixed with a great deal of hair. The legs of this mule were also an inch and a half longer than those of a lamb of the same age. When examined, eighteen days after birth, the white hairs were partly fallen off, and replaced by brown hairs, similar in colour to those in the he-goat, and nearly as coarse. The limbs continued to be more than an inch and a half longer than those of the lamb; and on account of this length of limbs it did not walk so well as the lamb. This lamb was killed by an accident; and I took no farther notice of the mule till four months afterward, when I compared it with a sheep of the same age. In the mule, from the space between the eyes to the extremity of the muzzle, the distance was at least an inch shorter than in the sheep; and the head of the mule was more than half an inch broader, at the broadest part. Hence the head of this mule was thicker and shorter than that of a sheep of equal age. The curvature of the upper jaw, taken from the corner of the mouth, was near half an inch longer in the mule than in the sheep. The head of the mule was not covered with wool, but with long bushy hair. The tail was two inches shorter than that of the sheep.

In the beginning of the year 1752 I obtained from the union of a he-goat with ewes eight other mules, six of which were males and two females. Two of them died before I could examine them; but they seemed to resemble those who survived. Two of them, a male and a female, had four teats, two on each side, like those of the goats. In general these mules had long hair on the belly, and particularly about the penis, as in the he-goat, and also on the feet, particularly those behind. Most of them had the chanfrin less arched than is common to lambs, the distance between the hoofs larger, and the tail shorter.

Under the article *dog* I related some experiments made with a view to procure an intermixture between a dog and a wolf, where all the precautions employed for that purpose were abortive. The conclusion drawn from these experiments was in the following words: ‘I pretend ‘not absolutely to affirm, that the wolf, in no age or ‘country, never intermixed with dogs. The contrary is ‘asserted positively by the ancients. Aristotle remarks, ‘that though animals of different species seldom inter‘mix; yet it certainly happens among dogs, foxes, and ‘wolves.’ I have since learned the propriety of being thus cautious in my conclusions; for M. le Marquis de Spontin-Beaufort has succeeded in the junction of a dog and a wolf. I was informed of this fact by M. Surirey de Boissy, in a letter which he wrote me in the following terms:

‘*Namur, June* 9, 1773.—The Marquis de Spontin has ‘in this place reared a very young she-wolf, to whom he ‘gave as a companion a dog of nearly the same age. ‘They were left at full liberty, and came into the apart‘ments, the kitchen, the stable, &c. They live in the ‘most intimate friendship, and are extremely caressing, ‘lying under the table, and upon the feet of the persons ‘who sit around.

‘The dog is a kind of mongrel mastiff, and full of ‘vigour. During the first six months the wolf was fed ‘with milk, and afterward with raw flesh, which it pre‘ferred to what was roasted. When she eat, no person ‘durst approach her. At other times she permitted ‘every freedom, except abuse. She caressed all the dogs ‘which came near her till she began to give a preference ‘to her old companion; after which she was enraged at ‘every other. She was covered, for the first time, on ‘the 25th day of March last. Her amours continued ‘fifteen days, with pretty frequent repetitions; and she ‘brought forth her young on the sixth day of June at ‘eight o’clock in the morning. Hence the time of her ‘gestation was seventy-three days. The young were ‘four in number, and of a blackish colour. Some of ‘them have the half of the breast and the pats white. ‘These colours are derived from the dog, which is black ‘and white. From the moment of littering she growled ‘and attacked all who approached her. She no longer ‘distinguished her masters; and would even have de‘voured the dog if he had come near her.

‘I add, that she has been chained ever since she made ‘a break at her gallant, who had leaped a neighbour‘ing wall, in order to come at a bitch in season; that ‘she nearly worried her rival; and that the coachman ‘separated them by repeated blows of a large bludgeon, ‘and conducted her to her lodge, where, imprudently ‘commencing his chastisement, her fury rose to such a ‘degree, that she bit him twice in the thigh, and the ‘wounds confined him six weeks to his bed.’

In my answer to this letter I thanked M. de Boissy, and added some remarks, with a view to remove my doubts. M. le Marquis de Spontin, having seen my answer, obligingly wrote me in the following terms:

‘*Namur, July* 14, 1773.—I read with much satisfac‘tion the judicious remarks you transmitted to M. Su‘rirey de Boissy, whom I had begged to communicate to ‘you, during my absence, a fact which cannot be denied, ‘notwithstanding the force of your arguments, and the ‘opinion I have always entertained, as well as the rest ‘of the world, of the excellence of the many learned ‘productions by which you have enlightened the republic ‘of letters. But whether it was an effect of chance, or ‘one of those sports of nature, who, as you remark, ‘sometimes departs from her established laws, the fact ‘is incontestible; and you will be convinced of its ‘truth, if you give credit to what I have the honour of ‘writing you, which can be attested by two hundred ‘persons at least, who were witnesses to it as well as ‘myself. This she-wolf was only three days old when ‘I purchased it from a peasant, who had carried it off ‘after killing the mother. I fed it with milk till it was ‘able to eat flesh. I recommended to those who had ‘the care of it to caress and handle it often, with a view ‘to render it as tame as possible. At last it became so ‘familiar that I have taken it to hunt in the woods at ‘the distance of a league from my house without any ‘danger of losing it. Sometimes, when I was unable to ‘call it back, it returned of its own accord in the night. ‘I was always more certain of keeping it at home when ‘I had a dog; for it was fond of dogs; and those who ‘had overcome their natural repugnance, sported with ‘it, as if they had been animals of the same species. ‘During all this time it attacked only cats and poultry, ‘whom it strangled without discovering any inclination ‘to eat them. As soon as she attained the age of twelve ‘months her ferocity increased, and I began to perceive ‘that she had a strong desire to attack sheep and ‘bitches. I then chained her; because she frequently ‘sprung upon her master when he attempted to restrain ‘her. She was at least one year old when I introduced ‘her to the acquaintance of the dog which covered her.

‘She has been kept in my garden, which is situated in the centre of the town, since the end of November last; and, therefore, no male wolf can be supposed to have had any communication with her. As soon as she came in season, she discovered such an affection for the dog, and the dog for her, that each of them howled frightfully when they were not together. She was first covered on the 28th day of March, and twice each day during the two following weeks. They continued attached to each other more than a quarter of an hour at every embrace, during which time the wolf complained, and seemed to suffer pain; but the dog was perfectly at his ease. Three weeks after, her pregnancy was perceptible. On the 6th day of June, she brought forth four young, whom she still suckles, though they are five weeks old, and have pretty long sharp teeth. They have a perfect resemblance to puppies, having long pendulous ears. One of them is black, with a white breast, which was the colour of the dog. The others will probably be of the colour of the mother. The hair of each of them is coarser than that of ordinary dogs. There is but one female, with a very short tail, like the dog, who had scarcely any tail. They promise to be large, strong, and very ferocious. The mother is extremely solicitous concerning their welfare.—I doubt whether I shall keep her any longer, having been chagrined by an accident that befel my coachman, whom she bit so cruelly that he has been confined to his bed these six weeks past. But I will engage, that if preserved she will again have puppies by the same dog, who is white, with large black spots on the back. I hope, Sir, that what I have said will answer for a reply to your remarks, and that you will no longer hesitate concerning the truth of this singular event.’

My doubts are entirely removed, and I am happy to embrace this opportunity of expressing my thanks. The establishment of a rare fact in natural history is a great acquisition. The means of attaining such facts are always difficult, and often, as we have seen, very dangerous. It was for this last reason that I sequestered my wolf and dog from all society. I had formerly reared a young wolf, who till the age of twelve months, did no mischief, and followed his master like a dog. But in the second year he committed so many excesses that it was necessary to kill him. I learned by experience, that these animals, though softened by education, resume with age their natural ferocity. Willing to prevent these inconveniences, I kept my she-wolf always confined along with the dog; and I acknowledge that this method of procuring an union between them was ill imagined; for in this state of slavery and disgust the dispositions of the wolf, instead of being softened, were soured to such a degree, that she was more ferocious than if she had been at full liberty; and the dog, having been early detached from his equals, and from the society of men, had assumed a savage and cruel character, which the bad humour of the wolf served only to augment; so that during the two last years their antipathy rose to such a degree, that they desired nothing so much as to devour each other. In the experiment made by the Marquis de Spontin every circumstance was reversed. The dog was in his ordinary condition: he had all the mildness and other qualities which this docile animal acquires by his intercourse with man. The wolf was likewise reared in perfect freedom and familiarity along with the dog, which, by being under no restraint, had lost his repugnance to her; and she, by the same mild management, became susceptible of attachment to him. She therefore received him with cordiality whenever the hour of nature struck: and though she seemed to complain and to suffer, she felt more pleasure than pain; for she allowed the operation to be repeated every day during all the time she was in season. Besides, the proper moment for this unnatural union was seized. The wolf felt the impression of love for the first time. She was only in the second year of her age; and of course had not entirely resumed her natural ferocity.

All these circumstances, and perhaps some others which were not observed, contributed to the success of this fertile embrace. From what has been remarked, it would appear, that the most certain method of rendering animals unfaithful to their species is to place them, like man, in society, and to accustom them gradually to individuals which, without such precautions, would not only be indifferent but hostile to each other. However this matter stands, the Marquis de Spontin has ascertained the fact, that the dog can produce with the wolf even in our climates. I could have wished that the success of this experiment had induced its author to try the union of a wolf with a bitch, and of foxes with dogs. But if this desire should be considered as exorbitant, he must ascribe it to the insatiable enthusiasm of a naturalist.

[A similar fact has been announced by M. Bourgelat, in a letter to me dated April 15, 1775: ‘My Lord Pembroke,’ says he, ‘informed me, that within these few days he saw a large mastiff copulate with a she-wolf; that the wolf is tame; that she is always in her master's chamber, and consequently under his eye; that she never goes out alone; and that she follows her master with all the fidelity of a dog. He adds, that an animal merchant has had, at four different times, mules produced by the wolf and dog. He alledges, that the wolf is only a wild dog; and in this opinion he is joined by the celebrated anatomist Mr. Hunter. He thinks differently with regard to the fox. He tells me, that a bitch, who was a daughter of a wolf, and be-

'longed to Lord Clanbrazil, intermixed with a setting 'dog, and produced puppies, which, according to his 'hunter, will be excellent pointers.']

But to return to our mules. In those I obtained from the he-goat and ewe, the number of males was as seven to two; in those from the dog and she-wolf, the males were as three to one; and in those from the goldfinch and Canary bird the males were as sixteen to three. It appears, therefore, to be certain, that the number of males, which is always greater than that of females in pure species, is still greater in mixed species. Hence, the male in general has a greater influence on the produce of generation than the female, because he transmits his sex to the greatest number, and because the number of males augments in proportion to the remoteness of the species which intermix. The same thing must happen in the conjunction of different races: by crossing the remotest of these, we shall not only procure the most beautiful productions but the greatest number of males. It is certain, from a thousand experiments, that both in men and the other animals, crossing the breed is the only mode of ennobling and preserving the perfection of the species.

To these facts and experiments let us add what the ancients have said upon this subject. Aristotle tells us, that the mule engenders with the mare, and that the junction produces an animal which the Greeks call *hinnus* or *ginnus*. He likewise remarks, that the she-mule easily conceives, but seldom brings the fœtus to perfection. Of these two facts the second is more rare than the first; and both happen only in warm climates. M. de Bory, of the royal academy of sciences, and formerly governor of the American islands, communicated to me a recent fact of this kind, in a letter dated May 7, 1770, of which the following is an extract.

'You will perhaps recollect, Sir, that M. d'Alembert 'read last year, in the academy of sciences, a letter which 'informed him, that a she-mule, in the island of St. 'Domingo, had brought forth a foal. I was desired to 'write for proper vouchers of the fact; and I have now 'the honour of sending you the certificate which I re'ceived. My correspondent is worthy of the highest 'credit. He adds, that he has seen mules cover indis'criminately she-mules and mares, and likewise she'mules covered by stallions and he-mules.'

This certificate is judicially attested, and signed by witnesses of unquestionable veracity. The substance of it is, that on the 14th day of May, 1769, M. de Nort, Knight of St. Louis, and late Major of the Royal Legion of St. Domingo, had a she-mule brought to him, which was said to be sick; that her belly was remarkably large, and a membrane protruded through the vagina. M. de Nort, believing the animal to be inflated, sent for a Negro farrier, who had been accustomed to take care of diseased animals; that this Negro, who arrived in the absence of M. de Nort, had thrown down the mule, in order to give her a draught; that the moment after the fall she brought forth a young mule, perfectly formed, and covered with long and very black hair; that the young mule lived an hour; but that, having been both hurt by the fall, the foal died soon after birth, and the mother ten hours after; and, in fine, that the young mule was skinned, and the skin sent, says M. de Nort, to Dr. Matty, who deposited it in the Museum of the Royal Society at London.

Other eye-witnesses, and particularly M. Cazavant, surgeon, add, that the young mule seemed to have been mature and well formed; that, from the appearance of its hair, head, and ears, it had a greater resemblance to the ass than common mules; that the paps of the mother were swelled, and full of milk; that when the ignorant Negro perceived the feet issuing from the vagina, he drew so forcibly as to invert the uterus, and lacerate the parts, which occasioned the death of both mother and foal.

These facts, which appear to be well ascertained, show, that in warm climates the mule is not only capable of conception, but of bringing the fœtus to full maturity. From my correspondents in Spain and Italy, I learn, that similar events have happened in these countries: but the facts are not so completely authenticated. It still remains to be inquired, whether this St. Domingo mule was impregnated by an ass or a mule. The superior resemblance of the young mule to the former seems to indicate, that she had been covered by an ass. The ferocious ardour of the ass renders him very indifferent in the choice of females, and makes him attack, with nearly the same avidity, the she-ass, the mare, and the mule.

We may therefore consider it as an established fact, that the he-mule can generate, and the she-mule produce. Like other animals they have a seminal liquor, and all the organs necessary to generation. But mongrel animals are always less fertile and more tardy than those of a pure species. Besides, mules have never produced in cold climates, seldom in warm regions, and still more seldom in temperate countries. Hence their barrenness, without being absolute, may be regarded as positive; since their productions are so rare, that a few examples only can be collected. But men were wrong in asserting that mules were absolutely barren, and that all animals proceeding from a mixture of different species were, like the mules, incapable of producing. The facts formerly related concerning the produce of a he-goat and a ewe, of a dog and a she-wolf, and of Canary birds and goldfinches, demonstrate, that these mongrels are by no means barren, and that some of them are equally prolific with their parents.

[To the above facts the translator has to add an instance of the prolific powers of a she-mule in the north of Scotland. Having heard that a mule, belonging to Mr. David Tullo, farmer in Auchtertyre, in the county of Forfar, had some years ago brought forth a foal, he transmitted a few queries to be put to Mr. Tullo; and requested that his answers might be legally attested before a magistrate. This request was chearfully complied with; and the following is an exact copy of the queries, answers, and attestations.

Interrogatories to be put to Mr. Tullo, tenant in Auchtertyre, parish of Newtyle, and county of Forfar, with his answers thereto.

1st. Had you ever a she-mule? At what period? Is it true that the mule had a foal? At what time was she covered; and when did she foal?

Answered by Mr. Tullo: That he bought a she-mule about twenty years ago: that she was constantly in season for a horse: that about four years thereafter he gave her a horse; and that she, thereafter, gave him a foal, about the 10th of June. The mule's price was four pounds five shillings sterling.

2d. What was the colour of the foal? Was there any thing particular in its figure?

Answer: The foal was exactly the colour of its mother, inclined to black, with a very large head, big ears, and small tail: and the declarant thinks, had its head been weighed when foaled, it would have weighed nearly as much as its body.

3d. How long was the animal allowed to live?

Answer: The next day after the mule foaled it was sent with its mother to the Loch of Lundie, in order to let the foal die, as the declarant could not want the mule's work, and the mother seemed not fond of the foal: that it was accordingly left, and next day came to Auchtertyre, about two miles distance, over a hill, with the cattle of Auchtertyre, that had been grazing near to that place, and was drowned in a ditch the day following.

4th. Was its skin preserved, or the head, or any other bones of the skeleton? Could any part thereof be still found?

Answered: Neither the skin nor any part of the skeleton was preserved, nor can now be had; though the declarant has often regretted the not preserving the foal, as its mother always performed any work that a horse of fifteen pounds value could do.

5th. Is the mother still alive? What is her age?

Answer: The mother died about eight years ago of an epidemic cold that was raging among the horses in this country: the mule had little or no milk after foaling, and the foal got some cow's milk: and this is all that he remembers of the matter.

DAVID TULLO.

Auchtertyre, 4th Feb. 1780.—We James Small, tenant in Burnmouth, and Robert Ramsay, tenant in Newtyle, hereby certify, that we have often seen the mule above described, and we know that she had a foal, as is narrated by David Tullo. JAMES SMALL.
ROBERT RAMSAY.

Ballantyne House, 4th Feb. 1780.—The within interrogatories were put to David Tullo, tenant in Auchtertyre, about the mule he had and the foal she produced, to which he gave the answers subjoined to each query, and signed them, as did James Small and Robert Ramsay, attesting the truth thereof, in the presence of

GEORGE WATSON, J. P.

The original attestation is in the possession of the translator; and he lately transmitted notorial or authenticated copies of it to the Count de Buffon, and to Thomas Pennant, Esq. of Downing, in Flintshire.]

It is an unhappy circumstance, that a small and often nominal error extends over every object to which it has any relation, and at last not only becomes an error in fact, but gives rise to a general prejudice that is more difficult to remove than the particular opinion from which it originated. A single word, a name like that of *mule*, which ought solely to represent the idea of the animal proceeding from the ass and mare, has been improperly applied to the animal produced by the horse and the she-ass, and afterward, with still greater impropriety, to all quadrupeds, and all birds, of mixed species: and as this word *mule*, in its original acceptation, included the idea of the barrenness common to the animal proceeding from the ass and mare, this idea of barrenness has been conveyed to all beings who have the denomination of *mules;* I say to all beings; for independent of quadrupeds, birds, and fishes, mule plants have been fancied, to which without hesitation this general sterility has also been ascribed. None of these beings, however, are absolutely barren. The *mule*, properly so called, or the animal produced by the ass and mare, is not absolutely barren; but its prolific powers, when compared with those of pure species, or even with those of other animals of a mixed species, are much more feeble and uncertain.

All mules, says prejudice, are vitiated animals incapable of producing: no animal, say reason and experience, though proceeding from two species, is absolutely barren. It ought to be remarked, however, that in pure as well as in mixed species, the degrees of fertility are very different. In the first, some, like the fishes and insects, multiply annually by millions; others, as the birds and small quadrupeds, produce by twenties and dozens; in fine, others, as man, and the larger quadrupeds, produce only one in twelve months. The number produced may be said to be in the inverse proportion of the magnitude of animals. The horse and ass bring forth but one in a year; and in the same period the mouse and Guinea pig produce thirty or forty. Hence the fecundity of these small animals is thirty or forty times greater; and if a scale were formed of the different degrees of fertility the small animals above enumerated would occupy the highest points, while the horse and ass would be found nearly in the lowest; for the elephant alone is less fertile.

In mixed species there are also different degrees of fecundity; for animals proceeding from two species partake of two natures, and are in general less fertile; and this want of fertility increases in proportion to the infecundity of the parents. Hence, if the horse and ass, two animals naturally not very fertile, mix, the original infecundity, instead of diminishing in the mongrel race, must be augmented. The mule will not only be less fertile than its parents, but perhaps the most unfertile of all mongrels, because all the other mules which produce, such as those proceeding from the he-goat and ewe, from the goldfinch and Canary bird, &c. are much more fruitful than those produced by the ass and horse. It is to this original and particular cause that the infecundity of the mule and bardeau should be referred. A second cause, still more particular, renders the last animal less prolific than the first. The mule proceeding from the ass and mare retains the ardent temperament of the father, and of course possesses a high degree of prolific power; while the bardeau, proceeding from the horse and ass is, like its father, less potent and less able to engender. Besides, the mare, being less ardent than the she-ass, is likewise more fertile, since she conceives and retains with more certainty. Thus every circumstance concurs in rendering the mule more prolific than the bardeau; for ardour of temperament in the male, which is so necessary to successful generation and the number produced, is hurtful in the female, and almost always prevents conception and retention.

This fact holds generally both in man and the other animals. Cold women, joined to ardent men, produce a number of children. A woman, on the contrary, who feels too acutely the emotions of love, is seldom fertile. But, in most women who are merely passive, the effect is more certain; because the fruit of generation is less disturbed by the convulsions of pleasure. These are so marked, and so destructive to the conception, in some females, such as the she-ass, that she requires cold water to be thrown on her crupper, and even heavy blows, in order to repress them. Without such disagreeable aids, the she-ass would seldom be impregnated, till age abated the fury of her passion. The same means are sometimes employed to make mares conceive.

But, it may be said, that female dogs and cats, which seem to be more ardent than the mare and she-ass, never fail to conceive; and, therefore, that the fact advanced concerning the infecundity of females whose feelings are exquisite, is too general, and admits of many exceptions. But the example of dogs and cats, instead of being an exception, is rather a confirmation of the general rule; for, in the bitch, however violent the convulsions of the internal organs may be supposed, they have full time to be appeased during the long interval between consummation and the retreat of the male, who cannot detach himself till the turgidity and irritation of the parts subside. The female cat is in a similar situation. Of all females, she appears to be the most ardent in her amours; for she calls to the males with lamentable cries, which announce the most pressing necessity. But, as in the dog, from a particular conformation of the male cat, this violent female never misses conception. Her desires, which are excessive, are necessarily tempered with a pain almost equally acute. The glans of the male cat is covered with large sharp prickles. The intromission of it, therefore, must be extremely painful to the female, who announces her sufferings by loud cries. The pain is so great, that she instantly makes every effort to escape, and the male, to retain her, is obliged to seize her by the neck with his teeth, and to compel submission from the very female who had invited his embraces.

In domestic animals, who are well fed and taken care of, multiplication is greater than in those who continue in a wild state. Of this we have an example in domestic dogs and cats, who produce several times every year; but, when in a natural state, they produce only once in the same period. Domestic birds furnish an example still more striking: can the fecundity of any species of wild birds be compared to that of a well-fed hen, when properly served with a cock? And, even in the human species, what a vast difference between the scanty propagation of savages, and the immense population of civilized nations, under the administration of a wise government!

The fecundity of mixed species, which is always less than that of the pure, merits particular attention. The reason will be apparent, by supposing, for example, that all the males in the horse species, and all the she-asses, or, rather, all the jack-asses and all the mares, were destroyed: in this case, those mixed animals alone, which we call *mules* and *bardeaux*, would be produced; and the number brought forth would be much fewer than that of horses or asses; because the natural conformities or relations between the horse and she-ass, or between the jack-ass and mare, are less than between the horse and mare, or the male and female ass. It is the number of conformities and dissimilarities which constitutes or distinguishes species; and, since the species of the ass has at all times been separated from that of the horse, it is apparent, that, by mixing these two species, whether by means of females or males, we diminish the number of conformities which constitute the species. Hence the males will engender and the females produce seldomer, and with more difficulty; and even those mixed species, if their conformities were fewer, would become entirely barren. Mules of every kind, therefore, must be rare; because it is only by being deprived of its natural female, that any animal will intermix with a female of a different species. Even when mongrel animals approach each other with some degree of warmth, their produce is neither so certain nor so frequent as in pure species, where the number of conformities is greater. Now, the produce of mixed species will be less frequent, in proportion to the infecundity of the pure species from whom they proceed; and the produce of animals proceeding from mixed species will always diminish in proportion as they recede from the original stock; because the conformities between them and any other animal are augmented. For example, I am persuaded, from the reasons above assigned, that an intercourse between two bardeaux would be abortive. Besides, these animals proceed from two species which are not very fertile, and are also under the influence of the same causes which often prevent the she-ass from conceiving with her own male. I am more uncertain with regard to the sterility of *mules* properly so called; because they are not liable to the last cause of barrenness; for, as the mare conceives more easily than the she-ass, and the jack-ass is more ardent than the horse, their respective prolific powers are greater, and their produce not so rare as that of the she-ass and horse. The mules, of course, will be less barren than the bardeaux. I suspect, however, that two mules never engender; and I presume, even from the examples of fertile mules, that they owe their impregnation to the ass, rather than to the mule; for we ought not to regard the he-mule as the natural male of the she-mule, though they both have the same name, or rather differ only in sex.

To explain this matter, let us suppose an order of kindred in species, like that which takes place in families. The horse and mare will be brother and sister in species, and parents in the first degree. It is the same with the male and female ass. But, if the male ass is given to the mare, they are only cousins in species, or kindred in the second degree. The mule produced by them, participating one half of both species, will be removed to the third degree of kindred. Hence the male and female mule, though proceeding from the same father and mother, instead of being brother and sister in species, are only kindred in the fourth degree; and, of course, will produce more difficultly between themselves, than the jack-ass and mare, who are kindred species in the second degree. For the same reason, the male and female mules will not produce so easily between themselves, as with the mare or ass; because the kindred of the latter in species is only in the third degree, while that of the former is in the fourth degree. The infecundity, which appears in the second degree, should be more conspicuous in the third, and perhaps absolute in the fourth.

In general, kindred of species is one of those mysteries of Nature, which man can never unravel, without a long continued and difficult series of experiments. How can we otherwise learn, than by the union of different species of animals many thousand times repeated, the degree of their kindred? Is the ass more allied to the horse than the zebra? Does the wolf approach nearer to the dog than the fox or jackal? At what distance from man shall we place the large apes, who resemble him so perfectly in conformation of body? Are all the species of animals the same now that they were originally? Has not their number augmented, instead of being diminished? Have not the feeble species been destroyed by the stronger, or by the tyranny of man, the number of whom has become a thousand times greater than that of any other large animal? What relation can be established between kindred species, and another kindred still better known, that of different races in the same species? Does not a race, like the mixed species, proceed from an anomalous individual, which forms the original stock? In the dog species, there is, perhaps, a race so rare, that it is more difficult to procreate than the mixed species proceeding from the ass and mare. How many questions does this subject admit of; and how few of them are we in a condition to solve? How many facts must be discovered before we can even form probable conjectures? However, instead of being discouraged, the philosopher ought to applaud Nature, even when she is most mysterious, and to rejoice that, in proportion as he removes one part of her veil, she exhibits an immensity of other objects, all worthy of his researches. For, what we already know ought to point out what may still be known. There is no boundary to the human intellect. It extends in proportion as the universe is displayed. Hence man can and ought to attempt every thing: he wants nothing but time to enable him to obtain universal knowledge. By multiplying his observations, he might foresee all the phænomena and all the events of Nature with equal certainty, as if he deduced them from their immediate causes: and what enthusiasm can be more pardonable, or rather more noble, than to believe that man is capable, by his labours, to discover all the powers and mysteries of Nature!

These labours consist chiefly in making observations and experiments, from which we discover new truths. For example, the union of animals of different species, by which alone we can learn their kindred, has never been sufficiently tried. The facts we have been able to collect concerning this union, whether voluntary or forced, are so few, that we are not in a condition to ascertain the existence of *jumars*. This name was first given to mules said to have proceeded from the bull and mare; but it has likewise been applied to denote mongrels alledged to have been procreated by the jack-ass and cow. Dr. Shaw tells us, that, in the provinces of Tunis and Algiers, ‘there is a little serviceable beast of ‘burden, called *kumrah*, begot betwixt an *ass* and *cow*. ‘That which I saw at Algiers (where it was not looked ‘upon as a rarity) was single hoofed like the ass, but ‘distinguished from it in having a sleeker skin, with ‘the tail and the head (though without horns) in fashion ‘of the dam’s.’

Thus we have already two kinds of jumars, the one proceeding from the bull and mare, and the other from the jack-ass and cow. A third is mentioned by Merolle, and is pretended to proceed from the bull and she-ass. ‘There was a beast of burden which proceeds from the ‘bull and she-ass, and is obtained by covering the ass ‘with a cow’s skin, in order to deceive the bull.’

But I am equally doubtful concerning the existence of all the three kinds of jumars; though I pretend not to deny the possibility of the fact. I have even enumerated some facts which prove an actual copulation between animals of very different species: but their embraces were ineffectual. Nothing seems to be more remote from the amiable character of the dog than the brutal manners and instinct of the hog; and the form of their bodies is as different as their natural dispositions. I have seen, however, two examples of a violent attachment between a dog and a sow. Even during this very summer 1774 a large spaniel discovered a violent passion for a sow which was in season: they were shut up together for several days; and all the domestics were witnesses of the mutual ardour of these two animals. The dog exerted many violent efforts to copulate with the sow; but the dissimilarity of their organs prevented their union. The same thing happened some years before. Hence animals, though of very different species, may contract a strong affection to each other; for it is certain, that in the above examples nothing prevented the union of the dog and sow but the conformation of their organs. It is not equally certain, however, that, if consummation had taken place, production would have followed. It often happens that animals of different species spontaneously unite. These voluntary unions ought to be prolific, since they imply that the natural repugnance, which is the chief obstacle, is surmounted, and also a conformity between the organs. No fertility, however, has resulted from such commixtures. Of this an example recently passed before my eyes. In 1767, and some succeeding years, the miller at my estate of Buffon kept a mare and a bull in the same stable, who contracted such a passion for each other, that as often as the mare came in season the bull covered her three or four times every day. These embraces were repeated during several years, and gave the master of the animals great hopes of seeing their offspring. Nothing, however, resulted from them. All the inhabitants of the place were witnesses to this fact, which proves, that in our climate at least the bull cannot procreate with the mare, and renders this first kind of jumar extremely suspicious. I have not equal evidence to oppose to the second kind, which Dr. Shaw says proceeds from the jack-ass and cow. I acknowledge, that though the dissimilarities in structure appear to be nearly equal in both cases, the positive testimony of a traveller so well informed as Dr. Shaw seems to give a greater degree of probability to the existence of this second kind of jumar than we have for the first. With regard to the third jumar, proceeding from the bull and she-ass, I am persuaded, notwithstanding the authority of Merolle, that it has no more existence than the one supposed to be produced by the bull and mare. The nature of the bull is still farther removed from that of the she-ass than from that of the mare: and the unfertility of the mare and bull, which is ascertained by the above examples, should apply with greater force to the union of the bull and ass.

THE NOMENCLATURE OF APES.

To teach children, and to address men, are two very different offices. Children receive without examination, and even with avidity, the arbitrary and the real, the true and the false, whenever they are presented to them under the form of precepts. Men, on the contrary, reject with contempt all precepts which are not founded on solid principles. We shall therefore adopt none of those methodical distributions by which, under the appellation of *ape*, a multitude of animals, belonging to very different species, have been huddled together in one indiscriminate mass.

What I call an *ape* is an animal without a tail, whose face is flat, whose teeth, hands, fingers, and nails, resemble those of man, and who, like him, walks erect on two feet. This definition, derived from the nature of the animal itself, and from its relations to man, excludes all animals who have tails; all those who have prominent faces or long muzzles; all those who have crooked or sharp claws; and all those who walk more willingly on four than on two legs. According to this precise idea let us examine how many species of animals ought to be ranked under the denomination of *ape*. The ancients knew only one. The *pithecos* of the Greeks, and the *simia* of the Latins, is a true *ape*, and was the subject upon which Aristotle, Pliny, and Galen instituted all the physical relations they discovered between that animal and man. But this ape, or pigmy of the ancients, which so strongly resembles man in external structure, and still more strongly in its internal organization, differs from him however by a quality, which, though relative in itself, is not the less essential. This quality is magnitude. The stature of man in general exceeds five feet; that of the *pithecos*, or pigmy, never rises above one fourth of this height. Hence, if this ape had been still more similar to man, the ancients would have been justified for regarding it only as an *homunculus*, an imperfect dwarf, a pigmy capable of combating with cranes; while man knew how to tame the elephant and conquer the lion.

But since the discovery of the southern regions of Africa and India, we have found another ape possessing this quality of magnitude; an ape as tall and as strong as man, and equally ardent for women as for its own females; an ape who knows how to bear arms, to attack his enemies with stones, and to defend himself with clubs. Besides, he resembles man still more than the pigmy; for independent of his having no tail, of his flat face, of the resemblance of his arms, hands, toes, and nails to ours, and of his walking constantly on end, he has a kind of visage with features which approach to those of the human countenance, a beard on his chin, and no more hair on his body than men have when in a state of nature. Hence the inhabitants of his country, the civilized Indians, have not hesitated to associate him with the human species, under the denomination of *orang-outang*, or *wild man;* while the Negroes, almost equally wild, and as ugly as these apes, who imagine not that civilization exalts our nature, have given it the appellation of *pongo*, which is the name of a beast, and has no relation to man. This orang-outang, or pongo, is only a brute, but a brute of a kind so singular, that man cannot behold it without contemplating himself, and without being thoroughly convinced that his body is not the most essential part of his nature.

Thus we have discovered two animals, the pigmy and the orang-outang, to which the name of *ape* ought to be applied. There is a third, to which, though more deformed, both in relation to man and to the ape, this appellation cannot be refused. This animal, which till now was unknown, and was brought from the East Indies under the name of *gibbon*, walks on end, like the other two, and has a flat face. He likewise wants a tail. But his arms, instead of being proportioned to the height of his body, like those of man, the orang-outang, or the pigmy, are so enormously long, that when standing on his two feet he touches the ground with his hands, without bending either his body or limbs. This ape is the third and last to which the name ought to be applied: in this genus he constitutes a singular or monstrous species, like the race of thick-legged men said to inhabit the island of Saint Thomas. [See the dissertation on the varieties of the human species in the first volume of this work.]

After the apes, another tribe of animals present themselves, to which we shall give the generic name of *baboon*. To distinguish them more accurately from the other kinds, let it be remarked, that the baboon has a short tail, a long face, a broad high muzzle, canine teeth, proportionally larger than those of man, and callosities on his buttocks. By this definition we exclude from the baboon tribe all the apes who have no tail; all the monkeys whose tails are as long or longer than their bodies; and all those who have thin, sharp pointed muzzles. The ancients had no proper names for these animals. Aristotle alone seems to have pointed out one of the baboons under the name of *simia porcaria*, though he has given but a very imperfect idea of the animal. [The denomination *simia porcaria*, which is employed by no other author but Aristotle, was not improperly applied to denote the baboon; for I find in the works of several travellers, who probably never read Aristotle, the muzzle of the baboon compared to the snout of a hog. Besides, these animals have some resemblance in the form of their bodies.] The Italians first called it *babuino;* the Germans, *bavion;* the French, *babouin;* the British, *baboon;* and all the modern writers of Latin, *papio*. We shall call it *baboon*, to distinguish it from the other species which have since been discovered in the southern regions of Africa and India. We are acquainted with three species of these animals: 1. The *baboon*, properly so called, which is found in Lybia, Arabia, &c. and is probably the *simia porcaria* of Aristotle. 2. The *mandrill*, or *ribbed-nose*, is still larger than the baboon, has a violet-coloured face, the nose and cheeks ribbed with deep oblique furrows, and is found in Guinea and in the warmest provinces of Africa. 3. The *ouanderou*, which is smaller than the baboon and mandrill; its body is thinner, its head and face are surrounded with a kind of long bushy mane, and it is found in Ceylon, Malabar, and other southern regions of India. Thus we have properly defined three species of apes and three species of baboons, which are all very different from one another.

But as nature knows none of our definitions, as she has not classed her productions by bundles or genera, and as her progress is always gradual and marked by minute shades, some intermediate animal should be found between the ape and baboon. This intermediate species actually exists, and is the animal which we call *magot*, or the *Barbary ape*. It occupies a middle station between our two definitions. It forms a shade between the apes and baboons. It differs from the first by having a long muzzle and large canine teeth; and from the second, because it actually wants the tail, though it has an appendix of skin which has the appearance of a very small tail. Of course it is neither an ape nor a baboon, but at the same time partakes of the nature of both. This animal, which is very common in Higher Egypt, as well as in Barbary, was known to the ancients. The Greeks and Romans called it *cynocephalus,* because its muzzle resembled that of a dog. Let us now arrange these animals in their proper order: the *orang-outang* is the first ape; the *pigmy* the second; and the *gibbon,* though different in figure, the third; the *cynocephalus* or *magot* the fourth ape, or the first baboon; the *papio* is the first baboon; the *mandrill* the second; and the *ouanderou,* or little baboon, the third. This order is neither arbitrary nor fictitious, but agreeable to the scale of nature.

After the apes and baboons, come the *guenons,* or *monkeys;* that is, animals resembling the apes and baboons, but which have tails as long, or longer than their bodies. The word *guenon* has, for some ages, had two acceptations different from that we have here given: it is generally employed to signify small apes, and sometimes to denote the female of the ape. But, more anciently, we called *singes,* or *magots,* the apes without a tail, and *guenons,* or *mones,* those which had long tails. This fact appears from the works of some travellers in the sixteenth and seventeenth centuries.

[In Senegal there are several species of apes, as the *guenons,* with a long tail; and the *magots,* who have no tail.—*La Maire.* In the mountains of South America, there is a kind of *mones,* or long-tailed monkeys, which the savages call *cacuyen.* They are of the same size with the common kind, from which they differ only by having a beard on their chin.—Along with these *mones,* there are found a number of small yellow animals, called *sagouins.—Thevet.*]

The word *guenon* is probably derived from *kebos,* or *kepos,* which the Greeks employed to denote the long-tailed apes. These *kebes,* or *guenons,* are smaller and weaker than the apes and baboons. They are easily distinguishable from one another by this difference, and particularly by their long tail. With equal ease they may be distinguished from the *makis* or *maucaucos;* because they have not a sharp muzzle, and, instead of six cutting teeth, like the makis, they have only four, like the apes and baboons. We know eight species of guenons; and, to prevent confusion, we shall bestow on each a proper name: 1. The *macaque,* or hare lipped monkey; 2. The *patas,* or red monkey; 3. The *malbrouk;* 4. The *mangabey,* or monkey with the upper eye-lids of a pure white colour; 5. The *mone,* or varied monkey; 6. The *callitrix,* or green monkey; 7. The *moustac,* or whiskered monkey; 8. The *talapoin;* 9. The *douc,* or monkey of Cochinchina. The ancient Greeks knew only two of these *guenons,* or long-tailed monkeys, namely, the mone and the callitrix, who are natives of Arabia and the northern parts of Africa. They had no idea of the other kinds; because these are found only in the southern provinces of Africa and the East Indies, countries entirely unknown in the days of Aristotle. This great philosopher, and the Greeks in general, were too wise to confound beings by common, and, therefore, equivocal names. They call the ape without a tail *pithecos,* and the monkey with a long tail, *kebos.* As they knew these animals to be distinct species, they gave to each a proper name, derived from their most striking characters. All the apes and baboons which they knew, namely the *pigmy,* the *cynocephalus,* or *magot,* and the *simia porcaria,* or *papio,* have their hair nearly of a uniform colour. But the monkey, which we have called *mone,* and the Greeks *kebos,* has hair of different colours, and is generally known by the name of the *varied ape.* This species of monkey was most common, and best known in the days of Aristotle; and from its most distinguished character, he calls it *kebos,* which, in Greek, signifies *varieties in colour.* Thus all the animals belonging to the class of apes, baboons, and monkeys, mentioned by Aristotle, are reduced to four, the *pithecos,* the *cynocephalus,* the *simia porcaria,* and the *kebos;* which we believe to be the *pigmy,* the *magot,* or Barbary ape, the *baboon,* and the *mone,* or varied monkey, not only because they agree with the characters given of them by Aristotle, but likewise because the other species must have been unknown to the ancients, since they are natives of countries into which the Greek travellers had never penetrated.

Two or three centuries after Aristotle, we find in the Greek writers, two new names, *callithrix* and *cercopithecos,* both relative to the *guenons,* or long-tailed monkeys. In proportion as discoveries were made of the southern regions of Africa and Asia, we found new animals, and other species of monkeys: and, as most of these monkeys had not, like the *kebos,* various colours, the Greeks invented the generic name *cercopithecos,* or *tailed ape,* to denote all the species of monkeys or apes with long tails; and, having remarked, among these new species, a monkey with hair of a lively greenish colour, they called it *callithrix,* which signifies *beautiful hair.* This callithrix is found in the south part of Mauritania, and in the neighbourhood of Cape de Verd, and is commonly known by the name of the *green ape.*

With regard to the other seven species of monkeys, mentioned above under the appellations of *makaque, patas, malbrouk, mangabey, moustac, talapoin,* and *douc,* they were unknown to the Greeks and Latins. The makaque is a native of Congo; the patas of Senegal; the mangabey, of Madagascar; the malbrouk, of Bengal; the moustac, of Guinea; the talapoin, of Siam; and the douc, of Cochinchina. All these territories were equally unknown to the ancients.

As the progress of nature is uniform and gradual, we find between the baboons and monkeys an intermediate species, like that of the magot between the apes and baboons. The animal which fills this interval has a great resemblance to the monkeys, particularly to the makaque; its muzzle, at the same time, is very broad, and its tail short, like that of the baboons. Being ignorant of its name we have called it *maimon*, or *pig-tailed baboon*, to distinguish it from the others. It is a native of Sumatra. Of all the monkeys or baboons it alone has a naked tail; and for this reason several authors have given it the denomination of the *pig-tailed* or *rat-tailed apes*.

We have now enumerated all the animals of the Old World to whom the common name of *ape* has been applied, though they belong not only to different species, but to different genera. To augment the confusion the same names of *ape*, *cynocephalus*, *kebos*, and *cercopithecos*, which had been invented by the Greeks fifteen centuries ago, have been bestowed on animals peculiar to the New World, though so recently discovered. They never dreamed that none of the African or East Indian animals had any existence in the southern regions of the New Continent. In America we have discovered animals with hands and fingers. This similarity was alone sufficient to procure to them the name of *apes*, without considering that, for the transference of a name, identity of genus, and even of species, is necessary. Now these American animals, of which we shall make two classes, under the appellations of *sapajous*, or monkeys with prehensile tails, and *sagoins*, or monkeys with long tails, which are not prehensile, or want the faculty of laying hold of any object, are very different from the apes of Asia and Africa; and in the same manner as no apes, baboons, or monkeys, are to be found in the New World, there are neither sapajous nor sagoins in the Old. Though we have already given a general view of these facts, in our dissertation concerning the animals of both Continents, we can now prove them in a more particular manner, and demonstrate, that of seventeen species, to which all the animals of the Old World, called *apes*, may be reduced, and of twelve or thirteen in the New World, to whom this name has been transferred, none of them are the same, or to be found equally in both Worlds; for of the seventeen species in the Old Continent, three or four apes must first be retrenched, who certainly exist not in America, and to whom the sapajous and sagoins have no resemblance. In the second place three or four baboons must likewise be retrenched: they are larger than the sapajous and sagoins, and also very different in figure. There remain only nine monkeys with whom any comparison can be instituted. Now all these monkeys, as well as the apes and baboons, have general and particular characters, which separate them entirely from the sapajous and sagoins. The first of these characters is to have naked buttocks, and natural callosities peculiar to these parts: the second is to have *abajoues*, or pouches under the cheeks, in which they can keep their victuals. The third is to have a narrow partition between the nostrils, and the apertures of the nostrils themselves placed in the under part of the nose, like those of man. The sapajous and sagoins have none of these characters. The partition between their nostrils is always very thick; the apertures of their nostrils are situated in the sides of the nose, and not in the under part of it. They have hair on their buttocks, and no callosities. They have no pouches under the cheeks. Hence they differ from the monkeys not only in species, but in genus, since they possess none of the general characters which are common to the whole tribe of monkeys. This difference of genus necessarily implies greater differences in species, and shows, that these animals are very remote from each other.

It is with much impropriety, therefore, that the names *ape* and *monkey* have been applied to the *sapajous* and *sagoins*. We must preserve their names, and instead of associating them with the apes, we should begin by comparing them with one another. These two tribes differ from each other by a remarkable character: all the sapajous use their tail as a finger to hang upon branches, or to lay hold of any object they cannot reach with their hand. The sagoins, on the contrary, have not the power of employing their tail in this manner. Their face, ears, and hair, are also different: we may therefore separate them into two distinct genera. In giving the history of the species I shall avoid all those denominations which can only apply to the apes, baboons, and monkeys, and preserve the names they receive in their native country.

We are acquainted with six or seven species of sapajous, and six of sagoins, most of which have some varieties. We have carefully searched all the writings of travellers in order to discover the proper name of each species; because the names they receive in the places they inhabit generally point out some peculiar characteristic, which alone is sufficient to distinguish them from one another.

With regard to the varieties, which in this class of animals are perhaps more numerous than the species, we shall endeavour to refer each of them to their proper kinds. We have had forty of these animals alive, each of which differed more or less from one another; and to us it appears that the whole may be reduced to thirty species, namely, three apes, and an intermediate species between them and the baboons; three baboons, and an intermediate species between them and the monkeys; nine monkeys; seven sapajous; and six sagoins. All the others, or at least most of them, ought to be regarded as varieties only. But as we are uncertain whether some of these varieties may not be distinct species, we shall endeavour to give all of them proper names.

On this occasion let us consider terrestrial animals, some of which have a great resemblance to man, in a new point of view. The whole have improperly received the general name of *quadrupeds.* If the exceptions were few, we would not have found fault with the application of this name. It was formerly remarked, that our definitions and denominations, however general, never comprehend the whole; that beings always exist which elude the most cautious definitions which ever were invented; that intermediate beings are always discovered; that several of them, though apparently holding a middle station, escape from the list; and that the general names, under which we mean to include them, are incomplete; because nature should be considered by unities only, and not by aggregates; because man has invented general denominations with the sole view of aiding his memory and supplying the defects of his understanding; and because he afterwards foolishly considered these general names as realities; and, in fine, because he has endeavoured to comprehend under them beings, and even whole classes of beings, which required different appellations. I can give an example, without departing from the class of quadrupeds, which of all animals we are best acquainted with, and of course were in a condition to have bestowed on them the most precise denominations.

The name *quadruped* supposes that the animal has *four feet.* If it wants two feet, like the manati; if it has arms and hands, like the ape; or if it has wings, like the bat; it is not a quadruped. Hence this general term, when applied to these animals, is abused. To obtain precision in words, the ideas they present must be strictly true. If we had a term for two hands similar to that which denotes two feet, we might then say that man was the only biped and *bimanus,* because he alone has two hands and two feet; that the manati is a *bimanus;* that the bat is only a biped; and that that the ape is a *quadrimanus,* or four-handed animal. Let us now apply these new denominations to all the particular beings to which they belong; and we shall find, that from about two hundred animals who go under the common name of *quadrupeds,* thirty-five species of apes, baboons, monkeys, sapajous, sagoins, and makis, must be retrenched, because they are *quadrimanus,* or four-handed; and that to these thirty-five species, the loris, or tailless maucauco, the Virginian, murine, and Mexican opossum, the Egyptian and woolly jerboas, &c. should be added, because they are four-handed, like the apes and monkeys. Thus the list of four-handed animals being at least forty species, the real number of quadrupeds is one-fifth diminished. We must likewise retrench twelve or fifteen species of bipeds, namely, the bats, whose fore-feet are rather wings than feet, and likewise three or four jerboas, because they can walk on their hind feet only, the fore feet being too short. If we subtract also the manati, which has no hind feet, the arctic and Indian walrus, and the seals, to whom the hind feet are useless; and if we still retrench those animals which use their fore feet like hands, as the bears, the marmots, the coatis, the agoutis, the squirrels, the rats, and many others, the denomination of *quadruped* will appear to be applied improperly to more than one half of these animals. The whole and cloven-hoofed are indeed the only real quadrupeds. When we descend to the digitated class, we find four-handed or ambiguous quadrupeds, who use their fore feet as hands, and ought to be separated or distinguished from the others. Of whole-hoofed animals there are three species, the horse, the ass, and the zebra. If to these we add the elephant, the rhinoceros, the hippopotamus, and the camel, whose feet, though terminated by nails, are solid, and serve the animals for walking only, we shall have seven species to which the name of quadruped is perfectly applicable. The number of cloven-hoofed animals greatly exceeds that of the whole-hoofed. The oxen, the sheep, the goats, the antilopes, the bubalus, the lama, the pacos, the giraffe, the elk, the rain deer, the stag, the fallow deer, the roebuck, &c. are all cloven-footed, and constitute about forty species. Thus we have already fifty animals, ten whole and forty cloven-hoofed, to whom the name quadruped is properly applied. In the digitated animals, the lion, tiger, panther, leopard, lynx, cat, wolf, dog, fox, hyæna, badger, pole-cat, weasels, ferret, porpucines, hedgehogs, armadillos, ant-eaters, and hogs, which last constitute the shade between the digitated and cloven footed tribes, form a number consisting of more than forty species, to which the term of quadruped applies with perfect precision; because, though their fore feet be divided into four or five toes, they are never used as hands. But all the other digitated species, who use their fore feet in carrying food to their mouths, are not, in strict propriety of language, quadrupeds. These species, which likewise amount to forty, make an intermediate class between quadrupeds and four-handed animals, being neither the one nor the other. Hence, to more than a fourth of our animals, the name of quadruped does not apply; and to more than a half of them the application of it is incomplete.

The four-handed animals fill the interval between man and the animals; and the two-handed species constitute a mean term in the distance between man and the cetaceous tribes. The bipeds with wings form the shade between quadrupeds and birds; and the digitated species, who use their fore feet as hands, fill the whole space between the quadrupeds and the four-handed kinds. But I will pursue this subject no farther: however useful it may be for acquiring a distinct knowledge of animals, it is still more so by affording a fresh proof that all our definitions or general terms want precision when applied to the objects or beings which they represent.

But why are these definitions and general terms, which appear to be the most brilliant exertions of the human intellect, so defective in their application? Does the error necessarily arise from the narrow limits of our understanding? Or rather does it not proceed solely from our incapacity of combining and perceiving at one time a great number of objects? Let us compare the works of nature with those of man. Let us examine how both operate, and inquire whether the mind, however acute, can follow the same route without losing itself in the immensity of space, in the obscurity of time, or in the infinity of related beings? When man directs his mind to any object, if his perceptions be accurate, he takes the straight line, runs over the smallest space, and employs the least possible time in accomplishing his end. What an expence of thought, how many combinations are necessary to avoid those deceitful and fallacious roads which at first present themselves in such numbers, that the choice of the right path requires the nicest discernment? This path, however, is not beyond the reach of the human intellect, which can proceed without deviating from the straight line. The mind is enabled to arrive at a point by means of a line; and if another point must be gained, it can only be attained by another line. The train of our ideas is a delicate thread, which extends in length, without any other dimensions. Nature, on the contrary, never moves a step which extends not on all sides, and runs at once through the three dimensions of length, breadth, and thickness. While man reaches but one point, Nature accomplishes a solid, by penetrating the whole parts which compose a mass. In bestowing form on brute matter, our statuaries, by the union of art and time, are enabled to make a surface which exactly represents the outside of an object. Every point of this surface requires a thousand combinations. Their genius is directly exerted upon as many lines as there are strokes in the figure. The smallest deviation would be a deformity. This marble, so perfect that it seems to breathe, is of course only a multitude of points at which the artist arrives by a long succession of labour; because human genius, being unable to seize more than one dimension at the same time, and our senses reaching no farther than surfaces, we cannot penetrate matter: but Nature in a moment puts every particle in motion. She produces forms by exertions almost instantaneous. She at once developes them in all their dimensions. As soon as her movements reach the surface the penetrating forces with which she is animated operate internally. The smallest atom, when she chooses to employ it, is instantly compelled to obey. Hence she acts at the same time on all sides, before, behind, above, below, on the right and left; and, consequently, she embraces not only the surface, but every particle of the mass. How different likewise is the product! What comparison is there between a statue and an organized body? How unequal, at the same time, are the powers, how disproportioned the instruments! Man can employ only the power he possesses. Limited to a small quantity of motion, which he can only communicate by the mode of impulsion, his exertions are confined to surfaces; because in general the impulsive force is only transmitted by superficial contact. He neither sees nor touches more than the surfaces of bodies; and when he wishes to attain a more intimate knowledge, though he opens and divides, still he sees and touches nothing more than their surfaces. To penetrate the interior parts of bodies he would require a portion of that force which acts upon the mass, or of gravity, which is Nature's chief instrument. If man could employ this penetrating force as he does that of impulsion, or if he had a sense relative to it, he would be enabled to perceive the essence of matter, and to arrange small portions of it, in the same manner as Nature operates at large. It is owing to the want of instruments, therefore, that human art cannot approach that of Nature. His figures, his pictures, his designs, are only surfaces, or imitations of surfaces; because the images he receives by his senses are all superficial, and he has no mode of giving them a body.

What is true with regard to the arts applies likewise to the sciences. The latter, however, are not so much limited; because the mind is their chief instrument, and because in the former it is subordinate to the senses. But in the sciences the mind commands the senses as often as it is employed in thinking and not in operating, in comparing and not in imitating. Now the mind, though bound up by the senses, though often deceived by their fallacious reports, is neither diminished in its purity nor activity. Man, who naturally loves knowledge, commenced by rectifying and demonstrating the errors of the senses. He has treated them as mechanical instruments, the effects of which must be submitted to the test of experiment. Proceeding thus with the balance in one hand, and the compass in the other, he has measured both time and space. He has recognised the whole outside of Nature; and being unable to penetrate her internal parts by his senses, his deductions concerning them have been drawn from comparison and analogy. He discovered that there exists in matter a general force different from that of impulsion, a force which falls not under the cognisance of our senses, and which, though we are incapable of using it, Nature employs as her universal agent. He has demonstrated, that this force belongs equally to all matter, in proportion to its mass or real quantity; and that its action extends to immense distances, decreasing as the spaces augment. Then, turning his views upon living beings, he perceived that heat was another force necessary to their production; that light was a matter endowed with infinite elasticity and activity; that the formation and expansion of organized bodies were effects of a combination of all these forces; that the extension and growth of animals and vegetables follow the laws of the attractive force, and are effected by an augmentation in the three dimensions at the same time; and that a mould, when once formed, must, by these laws of affinity, produce a succession of other moulds perfectly similar to the original. By combining these attributes, common to the animal and vegetable, he recognised, that there existed in both an inexhaustible circulating store of organic substance; a substance equally real as brute matter; a substance which continues always in a live as the other does in a dead state; a substance universally diffused, which passes from vegetables to animals by means of nutrition, returns from animals to vegetables by the process of putrefaction, and maintains a perpetual circulation for the animation of beings. He perceived, that these active organic particles existed in all organized bodies; that they were combined, in smaller or greater quantities, with dead matter; that they were more abundant in animals, in whom every thing is alive, and more rare in vegetables, in which death predominates, and life seems to be extinct, organization being surcharged with brute matter; and that plants are of course deprived of progressive motion, of heat, and of life, exhibiting no other quality of animation but expansion and reproduction. Reflecting on the manner in which these last are accomplished, he discovered that every living being is a mould that has the power of assimilating the substances with which it is nourished; that growth is an effect of this assimilation; that the developement of a living body is not a simple augmentation of volume, but an extension in all dimensions, a penetration of new matter through all parts of the mass; that these parts, by increasing proportionally to the whole, and the whole proportionally to the parts, the form is preserved, and continues always the same till growth is completed; that when the body has acquired its full expansion, the same matter, formerly employed in augmenting its volume, is returned as superfluous, from all the parts to which it had been assimilated, and by uniting in a common point forms a new being perfectly similar to the first, and to attain the same dimensions requires only to be developed by the same mode of nutrition. He perceived that man, quadrupeds, cetaceous animals, birds, reptiles, insects, trees, and herbs, were nourished, expanded, and reproduced by the same law; and that the mode of their nutrition and generation, though depending on the same general cause, appeared to be very different, because it could not operate but in a manner relative to the form of each particular species of being. Proceeding gradually in his investigation, he began after a succession of ages to compare objects. To distinguish them from each other he gave them particular names; and to unite them under one point of view he invented general terms. Taking his own body as the physical model of all animated beings, he measured, examined, and compared all their parts, and he discovered that the form of every animal which breathes is nearly the same; that by dissecting an ape we may learn the anatomy of a man; that, taking another animal, we always find the same fund of organization, the same senses, the same viscera, the same bones, the same flesh, the same motion of the fluids, the same play and action of the solids. In all of them he found a heart, veins, and arteries, and the same organs of circulation, respiration, digestion, nutrition, and secretion; in all of them he found a solid structure composed of the same pieces, and nearly situated in the same manner. This plan proceeds uniformly from man to the ape, from the ape to quadrupeds, from quadrupeds to cetaceous animals, to birds, to fishes, and to reptiles: this plan, I say, when well apprehended by the human intellect, exhibits a faithful picture of animated Nature, and affords the most general as well as the most simple view under which she can be considered: and when we want to extend it, and to pass from the animal to the vegetable, we perceive this plan, which had at first varied only by shades, gradually degenerating from reptiles to insects, from insects to worms, from worms to zoophytes, from zoophytes to plants; and though changed in all its external parts, still preserving the same character, the principal features of which are nutrition, growth, and reproduction. These features are common to all organized substances. They are eternal and divine; and instead of being effaced by time, it only renews and renders them more conspicuous.

If from this grand picture of resemblances exhibited in animated Nature as constituting but one family, we pass to that of the differences, where each species claims a separate apartment and a distinct portrait, we shall find that with the exception of a few large kinds, such as the elephant, the rhinoceros, the hippopotamus, the tiger, and the lion, which ought to have particular frames, all the others seem to unite with their neighbours, and to form groups of degraded similarities, or genera, represented by our nomenclators in a net-work of figures, some of which are supported by the feet, others by the teeth, by the hair, and others by relations still more minute: and even the apes, whose form seems to be most perfect, or approaches nearest to that of man, present themselves in a group, and require the utmost attention to be distinguished from each other; because the privilege of separate species depends less on figure than magnitude; and man himself, though a distinct species, and infinitely removed from that of all other animals, being only of a middle size, has a greater number of neighbouring species than the very large kinds. In the history of the orang-outang we shall find, that if figure alone be regarded we might consider this animal as the first of apes or the most imperfect of men; because, except the intellect, the orang-outang wants nothing that we possess, and, in his body, differs less from man than from the other animals which receive the denomination of *apes*.

Hence mind, reflection, and language depend not on figure, or on the organization of the body. These are endowments peculiar to man. The orang-outang, though he neither thinks nor speaks, has a body, members, senses, a brain, and a tongue perfectly similar to those of man: he counterfeits every human movement; but he performs no action that is characteristic of man. This imperfection is perhaps owing to want of education, or to an error in our judgment. You compare, it may be said, an ape in the woods with a man in polished society. But, in order to form a proper judgment of them, a savage man and an ape should be viewed together; for we have no just idea of man in a pure state of nature. The head covered with bristly hair, or with curled wool; the face veiled with a long beard; two crescents of hairs still grosser, by their length and prominency, contract the front, and not only obscure the eyes, but sink and round them like those of the brutes; the lips thick and protruded; the nose flat; the aspect wild and stupid; the ears, the body, and the members covered with hair; the breasts of the female long and flabby, and the skin of her belly hanging down as far as her knees; the children walowing in filth, and crawling on their hands and feet; the father and mother sitting squat on their hams, both hideous, and besmeared with corrupted grease. This sketch, drawn from a savage Hottentot, is a flattering portrait; for the distance between man in a pure state of nature and a Hottentot, is greater than between a Hottentot and us. But, if we want to compare the ape to man, we must add the relations of organization, the conformities of temperament, the vehement appetite of the males for the females, the same structure of genitals in both sexes, the periodic courses of the female, the voluntary or forced intermixture of the Negresses with the apes, the produce of which has entered into both species; and then consider, on the supposition that they are not the same, how difficult it is to perceive the interval by which they are separated.

If our judgment were limited to figure alone, I acknowledge that the ape might be regarded as a variety of the human species. The Creator has not formed man's body on a model absolutely different from that of the mere animal. He has comprehended the figure of man, as well as that of all other animals, under one general plan. But, at the same time that he has given him a material form similar to that of the ape, he has penetrated this animal body with a divine spirit. If he had conferred the same privilege, not on the ape, but on the meanest, and what appears to us to be the worst constructed animal, this species would soon have become the rival of man: it would have excelled all the other animals by thinking and speaking. Whatever resemblance, therefore, takes place between the Hottentot and the ape, the interval which separates them is immense; because the former is endowed with the faculties of thought and of speech.

Who will ever be able to ascertain how the organization of an idiot differs from that of another man? Yet the defect is certainly in the material organs, since the idiot is likewise endowed with a soul. Now, as between one man and another, where the whole structure is perfectly similar, a difference so small that it cannot be perceived is sufficient to prevent thought, we should not be surprised that it never appears in the ape, who is deprived of the necessary principle.

The soul, in general, has a proper action totally independent of matter. But, as its divine author has been pleased to unite it to the body, the exercise of its particular acts depends on the state of the material organs. This dependence is apparent, not only from the case of idiots, but from people affected with delirium, from sleep, from new born infants, who cannot think, and from very old men, whom the power of thinking has forsaken. It is even probable, that the chief effect of education consists not so much in instructing the mind, or maturing its operations, as in modifying the material organs, and bringing them into the most favourable state for the exercise of the sentient principle. Now, there are two kinds of education, which ought to be carefully distinguished, because their effects are extremely different; the education of the individual, which is common to man and the other animals; and the education of the species, which appertains to man alone. A young animal, both from natural incitements and from example, learns, in a few weeks, to do every thing its parents can perform. To an infant, several years are necessary before it acquires this degree of perfection; because, when brought forth, it is incomparably less advanced, weaker, and more imperfectly formed, than the smaller animals. In early infancy, the mind is nothing, when compared to the powers it will afterwards acquire. In receiving individual education, therefore, the infant is much slower than the brute; but, for this very reason, it becomes susceptible of that of the species. The multiplicity of succours, the continual cares, which the state of imbecility for a long time requires, cherish and augment the attachment of the parents. In training the body, they cultivate the mind. The time employed in strengthening the former gives an advantage to the latter. The bodily powers of most animals are more advanced in two months than those of the infant in two years. Hence the time employed in bestowing on the infant its individual education, is as twelve to one, without estimating the fruits of what follows after this period, without considering that animals separate from their parents as soon as they can provide for themselves, and that, not long after this separation, they know each other no more. All education ceases the moment that the aid of the parents becomes unnecessary. This time of education being so short, its effects must be very limited: it is even astonishing that the animals acquire in two months, all that is necessary for them during the rest of life: if we suppose that a child, in an equal period, were strong enough to quit its parents, and never return to them, would there be any perceptible difference between this infant and a brute? However ingenious the parents, they would not have time sufficient to modify and prepare his organs, or to establish the smallest communication of thought between their minds and his. They could not excite his memory by impressions frequently enough reiterated. They could not even mollify or unfold the organs of speech. Before a child can pronounce a single word, his ears must be struck many thousand times with the same sound; and, before he can make a proper application of it, the same combination of the word and the object to which it relates, must be many thousand times presented to him. Education, therefore, which alone can develope the powers of the mind, must be uninterruptedly continued for a long time. If stopt, not at two months, as in the animals, but even at the age of one year, the mind of the infant, having received no instruction, would remain inactive like that of the idiot, the defect of whose organs prevents the reception of knowledge. This reasoning would acquire redoubled strength, if the infant were born in a pure state of nature, if it were confined to the sole tutorage of a Hottentot mother, and were enabled by its bodily powers to separate from her at the age of two months, would it not sink below the condition of an idiot, and, with regard to its material part, be entirely levelled with the brutes? But in this condition of nature, the first education requires an equal time as in the civilized state; for in both, the infant is equally feeble, and equally slow in its growth; and, consequently demands the care of its parents during an equal period. In a word, if abandoned before the age of three years, it would infallibly perish. Now, this necessary, and so long continued intercourse between the mother and child, is sufficient to communicate to it all that she possesses: and though we should falsely suppose, that a mother, in a state of nature, possesses nothing, not even the faculty of speech, would not this long intercourse with her infant produce a language? Hence a state of pure nature, in which man is supposed neither to think nor speak, is imaginary, and never had an existence. This necessity of a long intercourse between parents and children produces society in the midst of a desert. The family understand each other both by signs and sounds; and this first ray of intelligence, when cherished, cultivated, and communicated, unfolds, in process of time, all the germs of cogitation. As this habitual intercourse could not subsist so long, without producing mutual signs and sounds, these signs and sounds, always repeated and gradually engraven on the memory of the child, would become permanent expressions. The catalogue of words, though short, forms a language which will soon extend as the family augments, and will always follow, in its improvement, the progress of society. As soon as society begins to be formed, the education of the infant is no longer individual, since the parents communicate to it not only what they derive from Nature, but likewise what they have received from their progenitors, and from the society to which they belong. It is no longer a communication between detached individuals, which, as in the animals, would be limited to the transmission of simple faculties, but an institution of which the whole species participate, and whose produce constitutes the basis and bond of society.

Even among brute animals, though deprived of the sentient principle, those whose education is longest appear to have most intelligence. The elephant, which takes the longest time in acquiring its full growth, and requires the succour of its mother during the whole first year of its existence, is also the most intelligent of all animals. The Guinea-pig, which is full grown, and capable of generating at the age of three weeks, is for this reason alone, perhaps, one of the most stupid species. With regard to the ape, whose nature we are endeavouring to ascertain, however similar to man, he is so strongly marked with the features of brutality, that it is distinguishable from the moment of his birth. He is then proportionally stronger and better formed than the infant: he grows faster: the support of his mother is necessary for a few months only: his education is purely individual, and consequently as limited as that of the other animals.

Hence the ape, notwithstanding his resemblance to man, is a brute, and, instead of approaching our species, holds not the first rank among the animals; because he is by no means the most intelligent. The relation of corporeal resemblance alone has given rise to the prejudice in favour of the great faculties of the ape. He resembles man, it has been said, both externally and internally; and therefore he must not only imitate us, but do every thing which we perform. We have seen, that all the actions which ought to be denominated *human*, are relative to society; that they depend, at first, on the mind, and afterwards on education, the physical principle of which is the long intercourse that necessarily subsists between the parents and children; that, in the ape, this intercourse is very short; that, like the other animals, he receives only an individual education; and that he is not susceptible of that of the species. Of course, he can perform no human actions, since no action of the ape has the same principle, or the same design. With regard to imitation, which appears to be the most striking character of the ape-kind, and which the vulgar have attributed to him as a peculiar talent, before we decide, it is necessary to inquire whether this imitation be spontaneous or forced. Does the ape imitate us from inclination, or because, without any exertion of the will, he feels the capacity of doing it? I appeal to all those who have examined this animal without prejudice, and I am convinced that they will agree with me, that there is nothing voluntary in this imitation. The ape, having arms and hands, uses them, as we do, but without thinking of us. The similarity of his members and organs necessarily produces movements, and sometimes successions of movements, which resemble ours. Being endowed with the human structure, the ape must move like man. But the same motions imply not that he acts from imitation. Two bodies which receive the same impulse, two similar pendulums or machines, will move in the same manner. But these bodies or machines can never be said to imitate each other in their motions. The ape and the human body are two machines similarly constructed, and necessarily move nearly in the same manner. But parity is not imitation. The one depends on matter, and the other on mind. Imitation pre-supposes the design of imitating. The ape is incapable of forming this design, which requires a train of thinking; and consequently man, if he inclines, can imitate the ape; but the ape cannot even incline to imitate man.

This parity is only the physical part of imitation, and by no means so complete as the similitude, from which, however, it proceeds as an immediate effect. The ape has a greater resemblance to us in his body and members, than in the use he makes of them. By observing him attentively, we easily perceive, that all his movements are brisk, intermittent, and precipitous; and that, in order to compare them with those of man, we must adopt another scale, or rather a different model. All the actions of the ape are derived from his education, which is purely animal. To us they appear ridiculous, inconsequent, and extravagant; because, by referring them to our own, we assume a false scale, and a deceitful mode of measuring. As his nature is vivacious, his temperament warm, his dispositions petulant, and none of his affections have been softened or restrained by education, all his habitudes are excessive, and resemble more the movements of a maniac than the actions of a man, or even of a peaceable animal. It is for this reason that we find him indocile, and that he receives with difficulty the impressions we wish to make on him. He is insensible to caresses, and is rendered obedient by chastisement alone. He may be kept in captivity, but not in a domestic state. Always melancholy, stubborn, repugnant, or making grimaces, he may be said to be rather conquered than tamed. The species, of course, have never been rendered domestic in any part of the world, and consequently is farther removed from man than most other animals: for docility implies some analogy between the giver and the receiver of instruction. It is a relative quality, which cannot be exerted but when there is a certain number of common faculties on both sides, that differ only between themselves, because they are active in the master, and passive in the scholar. Now, the passive qualities of the ape have less relation to the active qualities of man than those of the dog or elephant, who require no more than good treatment to communicate to them the delicate and gentle sensations of faithful attachment, voluntary obedience, grateful service, and unreserved devotion.

In relative qualities, therefore, the ape is farther removed from the human race than most other animals. His temperament is also very different. Man can inhabit every climate. He lives and multiplies in the northern as well as the southern regions of the earth. But the ape exists with difficulty in temperate countries, and can multiply only in those which are warm. This difference of temperament implies others in organization, which, though concealed, are not the less real: it must likewise have a great influence on his natural dispositions. The excess of heat, which is necessary to the constitution and vigour of this animal, renders all his qualities and affections inordinate. No other cause is requisite to account for his petulance, his salaciousness, and his other passions, which appear to be equally violent and disorderly.

Thus the ape, which philosophers, as well as the vulgar, have regarded as a being difficult to define, and whose nature was at least equivocal, and intermediate between that of man and the animals, is, in fact, nothing but a real brute, endowed with the external mark of humanity, but deprived of thought, and of every faculty which properly constitutes the human species; a brute inferior to many others in his relative powers, and still more essentially different from the human race by his nature, his temperament, and the time necessary to his education, gestation, growth, and duration of life; that is, by all the real habitudes which constitute what is called *Nature* in a particular being.

THE ORANG-OUTANGS, OR THE PONGO AND JOCKO.

WE shall give the history of these two animals under one article; because it is not improbable they belong to the same species. Of all the apes they have the greatest resemblance to man; and consequently deserve particular attention. We have seen the small orang-outang, or jocko, alive, and have preserved its skin. But of the pongo, or great orang-outang, we can only give the relations of travellers. If these were faithful, if they were not often obscure, false, and exaggerated, we could not hesitate in pronouncing it to be a different species from the jocko, a species more perfect, and approaching nearer to that of man. Bontius, who was chief physician of Batavia, and has left us some excellent remarks on the natural history of that part of the Indies, says expressly, that he saw with admiration some individuals of this species walking on two feet, and among others, a female (of which he gives a figure) who seemed to have a sense of modesty, who covered herself with her hand when men appeared of whom she had no acquaintance, who wept, groaned, and seemed to want nothing of humanity but the faculty of speech. Linnæus, upon the authority of Kjoep, and some other voyagers, tells us, that the orang-outang is not deprived of this faculty; that he thinks, speaks, and expresses himself by a kind of hissing words. This author calls him *homo nocturnus*, and at the same time gives such a description of him that it is impossible to ascertain whether he is a brute or a man. It may however be remarked, that, according to Linnæus, this being, whatever he is, exceeds not the half of the human stature; and as Bontius takes no notice of the magnitude of his orang-outang, we may presume that they are the same. But this orang-outang of Linnæus and Bontius would not be the true kind, which is larger than the tallest man. Neither is he the jocko, which I have seen alive; for though he was of the same size with that described by Linnæus, he differed in every other character. I saw him frequently, and I can affirm, that he neither spoke, nor expressed himself by hissing, and that he did nothing which a well trained dog could not perform. Besides, he differs in almost every article from Linnæus's description of the orang-outang, and corresponds better with the *satyrus* of the same author. For these reasons, I suspect the truth of the description of this *homo nocturnus*. I even doubt of his existence. It has probably been a white Negro, a Chacrelas, whom the voyagers quoted by Linnæus have superficially examined and falsely described. For the Chacrelas, like the *homo nocturnus* of this author, have white, woolly, frizzled hair, red eyes, a feeble voice, &c. But they are men, and neither hiss, nor are they pigmies of thirty inches high: they think and act like other men, and are also of the same size.

Throwing aside, therefore, this ill described being, and supposing a little exaggeration in the relation of Bontius concerning the modesty of his female orang-outang, there only remains a brute creature, an ape, of which we shall find more pointed information in writers of better credit. Edward Tyson, a celebrated English anatomist, who has given an excellent description both of the external and internal parts of the orang-outang, tells us, that there are two species, and that the one he described is not so large as the other, which is called *barris* or *baris* by travellers, and *drill* by the British. This *barris* or *drill* is the large orang-outang of the East Indies, or the pongo of Guinea. Gassendi having advanced, upon the authority of a voyager called *St. Amand*, that in the island of Java there was a creature which constituted the shade between man and the ape, the fact was strenuously denied. To prove it, Peiresc produced a letter from M. Noel, (*natalis*) a physician who resided in Africa, from which it appeared, that large apes were found in Guinea under the denomination of *barris*, who walk on two legs, have much more gravity and intelligence than the other species, and are extremely desirous of women. Darcos, and afterwards Nieremberg, and Dapper, give nearly the same account of the barris. Battel calls it *pongo*, and describes it in the following manner: 'The greatest of these two monsters 'is called *pongo* in their language; and the lesser is 'called *engeco*. This *pongo* is exactly proportioned like 'a man; but he is more like a giant in stature; for he 'is very tall, and hath a man's face, hollow eyed, with 'long hair upon his brows. His face and ears are with-'out hair, and his hands also. His body is full of hair, 'but not very thick, and it is of a dunnish colour. He 'differeth not from a man but in his legs, for they have 'no calf. He goeth always upon his legs, and carrieth 'his hands clasped on the nape of his neck, when he 'goeth upon the ground. They sleep in the trees, and 'build shelters for the rain. They feed upon fruit that 'they find in the woods, and upon nuts, for they eat no 'kind of flesh. They cannot speak, and have no under-'standing more than a beast. The people of the coun-'try, when they travel in the woods, make fires where 'they sleep in the night; and in the morning, when 'they are gone, the pongos will come and sit about the 'fire till it goeth out; for they have no understanding 'to lay the wood together. They go many together, 'and kill many Negroes that travail in the woods. 'Many times they fall upon the elephants, which come to feed where they be, and so beat them with their clubbed fists and pieces of wood, that they will run roaring away from them. Those pongos are never taken alive, because they are so strong that ten men cannot hold one of them; but yet they take many of their young ones with poisoned arrows. The young pongo hangeth on his mother's belly, with his hands fast clasped about her; so that, when the country people kill any of the females they take the young one, which hangeth fast upon his mother.' It is from this very explicit passage that I have derived the names *pongo* and *jocko*. Battel farther remarks, that when one of these animals dies, the others cover his body with branches and leaves of trees. Purchas adds in a note, that in the conversations he had with Battel, he learned that a pongo carried off a young Negro from him, who lived a whole year in the society of these animals; that on his return the Negro said that they had never injured him; that they were generally as tall as a man, but much thicker; and that they were nearly double the volume of an ordinary man. Jobson assures us, that in places frequented by these animals he saw a kind of habitations composed of interlaced branches of trees, which would at least protect them from the scorching rays of the sun. 'The apes of Guinea,' says Bosman, 'which are called *smitten* by the Flemish, are of a yellow colour, and grow to a great size. I saw with my eyes one which was five feet high. These apes have an ugly appearance, as well as those of another species perfectly similar in every respect except that four of them would hardly be as large as one of the former kind. They are capable of being taught almost every thing we choose.' Gauthier Schoutten remarks, 'that the apes called *orang-outangs* by the Indians are nearly of the same figure and size with men, only their back and reins are covered with hair, though there is no hair on the fore part of their bodies; that the females have two large breasts; that their visage is coarse, their nose flat, and even sunk, and their ears like those of men; that they are robust and active; that they defend themselves against armed men; that they are passionately fond of women, who cannot pass through the woods without being suddenly attacked and ravished by these apes.' Dampier, Froger, and other travellers, assure us, that the orang-outangs carry off girls of eight or ten years of age to the tops of trees, and that it is extremely difficult to rescue them. To these testimonies we may add that of M. de la Brosse, who assures us, in his voyage to Angola in the year 1738, that the orang-outangs, which he calls *quimpezes*, 'endeavour to surprise the Negresses, whom they detain for the purpose of enjoying them, and entertain them plentifully. I knew a Negress at Loango who remained three years with these animals. They grow from six to seven feet high. They erect huts, and use bludgeons in their own defence. They have flat faces, broad flat noses, flat ears, skins clearer than those of Molattoes, long thinly scattered hairs on several parts of their bodies, bellies extremely tense, and flat heels raised behind about half an inch. They walk upon two or four feet at pleasure. We purchased two young ones, a male of fourteen months of age, and a female of twelve,' &c.

We have thus enumerated the most certain facts we could collect concerning the great *orang-outang* or *pongo;* and as magnitude is the chief character by which it differs from the jocko, I persist in thinking that they are of the same species: for two circumstances are at least possible: 1. The jocko may be a permanent variety, a race much smaller than that of the pongo. In fact, they both inhabit the same climate; they live in the same manner; and of course ought to resemble each other in every article, since they both receive equally the influences of the same soil and sky. In the human species have we not an example of a similar variety? The Laplander and Fin, though they live under the same climate, differ nearly as much in stature, and much more in other qualities, than the jocko differs from the orang-outang. 2. The jocko, or small orang-outang, which we have seen alive, as well as those of Tulpius, Tyson, and others which have been brought to Europe, were all perhaps young animals, who had acquired only a part of their growth. The one I saw was about two feet and a half high; and the Sieur Nonfoux, to whom it belonged, assured me that it exceeded not two years of age. On the supposition, therefore, that its growth were proportional to that of man, it might, if it had lived, have arrived at the height of more than five feet. The orang-outang of Tyson was still younger; for it was only about two feet high, and its teeth were not perfectly formed. Those of Tulpius and Edwards were nearly of the same stature with the one I saw. Hence it is probable, that these young animals, if possessed of liberty in their own climate, would have acquired with age the same height and dimensions which travellers have ascribed to the great orang-outang. Of course, till better information be received, we must regard these two animals as constituting but one species.

The orang-outang which I saw walked always on two feet, even when carrying things of considerable weight. His air was melancholy, his gait grave, his movements measured, his dispositions gentle, and very different from those of other apes. He had neither the impatience of the Barbary ape, the maliciousness of the baboon, nor the extravagance of the monkeys. It may be alledged, that he had the benefit of instruction; but the other apes, which I shall compare with him, were educated in the same manner. Signs and words were alone sufficient to make our orang-outang act: but the baboon required a cudgel, and the other apes a whip, for none of them would obey without blows. I have seen this animal present his hand to conduct the people who came to visit him, and walk as gravely along with them as if he had formed a part of the company. I have seen him sit down at table, unfold his towel, wipe his lips, use a spoon or a fork to carry the victuals to his mouth, pour his liquor into a glass, and make it touch that of the person who drank along with him. When invited to take tea, he brought a cup and saucer, placed them on the table, put in sugar, poured out the tea, and allowed it to cool before he drank it. All these actions he performed, without any other instigation than the signs or verbal orders of his master, and often of his own accord. He did no injury to any person: he even approached company with circumspection, and presented himself as if he wanted to be caressed. He was very fond of dainties, which every body gave him: and, as his breast was diseased, and he was afflicted with a teazing cough, this quantity of sweetmeats undoubtedly contributed to shorten his life. He lived one summer in Paris, and died in London the following winter. He ate almost every thing; but preferred ripe and dry fruits to all other kinds of food. He drank a little wine; but spontaneously left it for milk, tea, or other mild liquors. Tulpius, who gives a good description and a figure of one of these animals, that had been presented to Frederick Henry, Prince of Orange, makes nearly the same observations with regard to it, as I have already related. But, if we wish to distinguish the instincts peculiar to this animal from the improvement it receives by education, we must compare the facts of which we have been eye-witnesses, with the relations of travellers who have seen it in a state of nature, in the full possession of liberty, and in captivity. M. de la Brosse, who purchased from a Negro two orang-outangs, whose age exceeded not twelve months, does not say that they had been instructed by the Negro. It appears, on the contrary, that they spontaneously performed most of the actions above recited. ‘These animals,’ he remarks, ‘ have the instinct of sitting at table like men. They ‘ eat every kind of food, without distinction. They use ‘ a knife, a fork, or a spoon, to cut or lay hold of what ‘ is put in their plate. They drink wine and other ‘ liquors. We carried them abroad. At table, when ‘ they wanted any thing, they made themselves be ‘ understood to the cabin-boy: and, when the boy ‘ refused to give them what they demanded, they some- ‘ times became enraged, seized him by the arm, bit, ‘ and threw him down. The male was seized with ‘ sickness on the road. He made himself be attended ‘ as a human being. He was even bled twice in the ‘ right arm: and, whenever he found himself afterwards ‘ in the same condition, he held out his arm to be bled, ‘ as if he knew that he had formerly received benefit ‘ from that operation.’

Henry Goss informs us, ‘That some places towards ‘ the hills are covered with immense impenetrable forests, ‘ which afford a shelter for wild beasts of all sorts. But ‘ in that which forms the inland boundary of the Car- ‘ natic Rajah’s dominions, there is one singular species ‘ of creatures, of which I had heard much in India, and ‘ the truth of which the following fact, that happened ‘ some time before my arrival there, may serve for an ‘ attestation.

‘ Vancajee, a merchant of that country, and an inha- ‘ bitant on the sea coast, sent up to Bombay to the then ‘ governor of it, Mr. Horne, a couple of those creatures ‘ before mentioned, as a present, by a coasting vessel, ‘ of which one Captain Boag was the master, and the ‘ make of which, according to his description, and that ‘ of others, was as follows:

‘ They were scarcely two feet high, walked erect, and ‘ had perfectly a human form. They were of a sallow ‘ white, without any hair, except in those parts that it is ‘ customary for mankind to have it. By their melan- ‘ choly, they seemed to have a rational sense of their ‘ captivity, and had many of the human actions. They made their bed very orderly in the cage in which they ‘ were sent up, and on being viewed, would endeavour ‘ to conceal, with their hands, those parts that modesty ‘ forbids manifesting. The joints of their knees were ‘ not re-entering, like those of monkers, but saliant, ‘ like those of men; a circumstance they have (if I mis- ‘ take not), in common with the orang-outangs in the ‘ eastern parts of India, in Sumatra, Java, and the spice- ‘ islands, of which these seem to be the diminutives, ‘ though with nearer approaches of resemblance to the ‘ human species. But, though the navigation from the ‘ Carnatic coast to Bombay is of a very short run, of ‘ not above six or seven degrees, whether the sea air ‘ did not agree with them, or that they could not brook ‘ their confinement, or that Captain Boag had not pro- ‘ perly consulted their provisions, the female sickening ‘ first, died; and the male giving all the demonstrations ‘ of grief, seemed to take it to heart so, that he refused ‘ to eat, and, in two days after, followed her. The ‘ captain, on his return to Bombay, reported this to the ‘ governor, was by him asked, What he had done with ‘ the bodies? He said he had flung them over-board. ‘ Being further asked, why he did not keep them in ‘ spirits? he replied bluntly, that he did not think of it. ‘ Upon this, the governor wrote afresh to Vancajee, and ‘ desired him to procure another couple, at any rate, as ‘ he should grudge no expence to be master of such a ‘ curiosity. Vancajee’s answer was, he should very ‘ willingly oblige him, but that he was afraid it would ‘ not be in his power: that these creatures came from 'a forest about seventy leagues up the country, where 'the inhabitants would sometimes catch them on the 'skirts of it; but that they were so exquisitely cunning 'and sly, that this scarcely happened once in a century.'

Francis Pyrard relates, 'That in the province of 'Sierra Leone, there is a species of animals called *baris*, 'who are strong and well limbed, and so industrious, that 'when properly trained and fed, they work like servants; 'that they generally walk on the two hind feet; that 'they pound any substances in a mortar; that they go 'to bring water from the river in small pitchers, which 'they carry full on their heads. But when they arrive 'at the door, if the pitchers are not soon taken off, they 'allow them to fall; and when they perceive the pitcher 'overturned and broken, they weep and lament.' Father Jarric, quoted by Nieremberg, says the same thing, nearly in the same terms. With regard to the education of these animals, the testimony of Schoutten accords with that of Pyrard. 'They are taken,' he remarks, 'with snares, taught to walk on their hind feet, and to 'use their fore feet as hands in performing different 'operations, as rinsing glasses, carrying drink round 'the company, turning a spit,' &c. 'I saw, at Java,' says Guat, 'a very extraordinary ape. It was a female. 'She was very tall, and often walked erect on her hind 'feet. On these occasions, she concealed with her 'hands the parts which distinguish the sex. Except 'the eye-brows, there was no hair on her face, which 'pretty much resembled the grotesque female faces I 'saw among the Hottentots at the Cape. She made 'her bed very neatly every day, lay upon her side, and 'covered herself with the bed-clothes. When her head 'ached, she bound it up with a handkerchief; and it 'was amusing to see her thus hooded in bed. I could 'relate many other little articles which appeared to be 'extremely singular. But I admired them not so much 'as the multitude; because, as I knew the design of 'bringing her to Europe to be exhibited as a shew, I 'was inclined to think that she had been taught many 'of these monkey-tricks, which the people considered as 'being natural to the animal. She died in our ship, about 'the latitude of the Cape of Good Hope. The figure 'of this ape had a very great resemblance to that of 'man,' &c. Gemelli Carreri tells us, that he saw one of these apes, which cried like an infant, walked upon its hind feet, and carried a mat under his arm to lie down and sleep upon. These apes, he adds, appear, in some respects, to have more sagacity than men: for when the fruits on the mountains are exhausted, they come down to the sea-coasts, where they feed upon crabs, oysters, and other shell-fishes. There is a species of oyster called *taclovo*, which weighs several pounds, and commonly lies open on the shore. The ape, when he wants to eat one of them, being afraid lest it should close on his paw, puts a stone into the shell, which prevents it from shutting, and then eats the oyster at his ease.

'The apes along the banks of the river Gambia,' says Froger, 'are larger and more mischievous than in 'any other part of Africa: the Negroes dread them, 'and cannot travel alone in the country without running 'the hazard of being attacked by these animals, who 'often present them with a stick, and force them to 'fight. I have heard the Portuguese say, that they 'have frequently seen them hoist up young girls, about 'seven or eight years old, into trees, and that they could 'not be wrested from them without a great deal of dif'ficulty. The most part of the Negroes imagine them 'to be a foreign nation come to inhabit their country, 'and that they do not speak for fear of being compelled 'to work.'

'We might dispense,' another traveller remarks, 'with seeing a number of apes at Macacar; because a 'rencounter with them is often fatal. It is necessary to 'be always well armed to defend ourselves against their 'attacks. They have no tail, and walk always erect on 'their two hind feet, like men.'

These are nearly all the facts, concerning this animal, which have been related by voyagers who are least credulous, and deserve most credit. I have quoted the passages entire, because every article is important in the history of a brute which has so great a resemblance to man. And that we may be enabled to ascertain the nature of this animal with the greater precision, we shall now mark the differences and conformities which make him approach or recede from the human species. He differs from man externally by the flatness of his nose, by the shortness of his front, and by his chin, which is not elevated at the base. His ears are proportionally too large, his eyes too near each other, and the distance between his nose and mouth is too great. These are the only differences between the face of an orang-outang and that of a man. With regard to the body and members, the thighs are proportionally too short, the arms too long, the fingers too small, the palm of the hands too long and narrow, and the feet rather resemble hands than the human foot. The male organs of generation differ not from those of man, except that the prepuce has no *frænum*. The female organs are extremely similar to those of a woman.

The orang-outang differs internally from the human species in the number of ribs: man has only twelve; but the orang-outang has thirteen. The vertebræ of the neck are also shorter, the bones of the pelvis narrow, the buttocks flatter, and the orbits of the eyes sunk deeper. He has no spinal process on the first vertebra of the neck. The kidneys are rounder than those of man, and the ureters have a different figure, as well as the bladder and gall-bladder, which are narrower and longer than in the human species. All the other parts of the body, head, and members, both external and internal, so perfectly resemble those of man, that we cannot make the comparison without being astonished that such a similarity in structure and organization should not produce the same effects. The tongue, and all the organs of speech, for example, are the same as in man; and yet the orang-outang enjoys not the faculty of speaking; the brain has the same figure and proportions; and yet he possesses not the power of thinking. Can there be a more evident proof than is exhibited in the orang-outang, that matter alone, though perfectly organized, can produce neither language nor thought, unless it be animated by a superior principle? Man and the orang-outang are the only animals who have buttocks and calfs of the legs, and who, of course, are formed for walking erect; the only animals who have a broad chest, flat shoulders, and vertebræ of the same structure; and the only animals whose brain, heart, lungs, liver, spleen, stomach, and intestines are perfectly similar, and who have an appendix vermiformis or blind-gut. In fine, the orang-outang has a greater resemblance to man than even to the baboons or monkeys, not only in all the parts we have mentioned, but in the largeness of the face, the figure of the cranium, of the jaws, of the teeth, and of the other bones of the head and face; in the thickness of the fingers and thumb, the figure of the nails, and the number of vertebræ; and, lastly, in the conformity of the articulations, the magnitude and figure of the rotula, sternum, &c. Hence, as there is a greater similarity between this animal and man than between those creatures which resemble him most, as the Barbary ape, the baboon, and monkey, who have all been designed by the general name of *apes*, the Indians are to be excused for associating him with the human species under the denomination of *orang-outang* or *wild man*. As some of the facts we have related may appear suspicious to those who never saw this animal, we shall support them by the authority of two celebrated anatomists. Tyson and Couper dissected him with the most scrupulous exactness, and have given us the results of the comparisons they made between the different parts of his body with that of man. I have copied this article, that the reader may be enabled to form a judgment of the almost entire resemblance between this animal and the human species.

[The orang-outang has a greater resemblance to man than to the apes or monkeys; because, 1. The hairs on his shoulders are directed downward, and those of the arms upward. 2. His face is broader and flatter than that of the apes. 3. The figure of his ear has a greater resemblance to that of man, except the cartilaginous part, which is thin, as in the apes. 4. His fingers are proportionally thicker than those of the apes. 5. He is in every article formed for walking erect, which is by no means the case with the apes and monkeys. 6. He has thicker buttocks than all the other apes. 7. He has calfs to his legs. 8. His breast and shoulders are broader than those of the apes. 9. His heel is longer. 10. He has a cellular membrane, placed, as in man, under the skin. 11. His peritonæum is entire, and not pierced or lengthened, as it is in the apes. 12. His intestines are longer than those of the apes. 13. The intestinal canal is of different diameters, as in man, and not equal, or nearly equal, as in the apes. 14. His cæcum has a vermicular appendix, as in man; but this appendix is wanting in all the other apes: besides, the neck of the colon is not so long as that of the apes. 15. The insertions of the biliary and pancreatic ducts have but one common orifice in man and the orang-outang; but in the monkeys these insertions are two inches asunder. 16. The colon is longer than that of the apes. 17. The liver is not divided into lobes, as in the apes, but entire, as in man. 18. The biliary vessels are the same as in man. 19. The spleen, and 20, the pancreas, are the same. 21. The number of lobes in the lungs is the same. 22. The pericardium is attached to the diaphragm, as in man. 23. The cone of the heart is blunter than in the apes. 24. He has no pouches at the bottom of the cheeks, as the other apes and monkeys have. 25. His brain is larger than that of the apes, and exactly formed like the human brain. 26. The cranium is rounder, and double the size of that of the monkeys. 27. All the sutures of the cranium are similar to those of man; and the bones called *ossa triquetra Wormiana* are found in the lamboid suture, which is not the case in the other apes or monkeys. 28. He has the *os cribriforme* and the *crista galli*, which are wanting in the monkeys. 29. He has the *sella equina* exactly as in man; but in the apes and monkeys this part is more elevated and prominent. 30. The processus pteregoideus is the same as in man; but it is wanting in the apes and monkeys. 31. The temporal bones, and those called *ossa bregmatis*, are the same as in man; but in the apes and monkeys these bones are of a different form. 32. The os zygomaticus is small; but it is large in the apes and monkeys. 33. The teeth, and particularly the dog teeth and grinders, are more similar to the human teeth than to those of the apes. 34. The transverse processes of the vertebræ of the neck, and the sixth and seventh vertebræ, have a greater resemblance to those of man than to those of the apes and monkeys. 35. The vertebræ of the neck are not perforated, as in the apes, for the transmission of nerves, but plain and entire, as in man. 36. The vertebræ of the back and their processes are the same as in man; and in the lower vertebræ there are only two inferior processes; but in the apes there are four. 37. As in man there are only five lumbar vertebræ; but in the monkeys there are six or seven. 38. The spinal processes of the lumbar vertebræ are straight, as in man. 39. The *os sacrum* is composed of five vertebræ, as in man; but in the apes and monkeys it consists only of three. 40. The coccix is composed of four bones, as in man, and these bones are not perforated; but in the apes and monkeys the coccix is composed of a greater number of bones, which are all perforated. 41. In the orang-outang there are only seven true ribs (*costæ veræ*) and the extremities of the false ribs (*costæ nothæ*) are all cartilaginous, and articulated with the bodies of the vertebræ; but in the apes and monkeys there are eight true ribs, and the extremities of the false ribs are osseous, and their articulations are placed in the interstices between the vertebræ. 42. The sternum of the orang-outang is as broad as that of man, and not narrow, as in the monkeys. 43. The bones of the four fingers are thicker than those of the apes. 44. The thigh bone is perfectly similar to that of man. 45. The rotula is round, and not long, single, and not double, as it is in the apes. 46. The heel, the *tarsus*, and *metatarsus* are the same as those of man. 47. The middle toe is not so long as in the apes. 48. The *obliquus inferior capitis, pyriformis,* and *biceps femoris* muscles, are similar to those of man; but they are different in the apes and monkeys, &c.

The orang-outang differs from the human species more than from the apes and monkeys in the following articles. 1. The thumb is proportionally smaller than that of man; but it is larger than that of the other apes. 2. The palm of the hand is longer and narrower than in man. 3. He differs from man, and approaches the apes by the length of his toes. 4. He differs from man by having the large toe of the foot removed nearly to the distance of an inch from the next one, and he should be rather considered as a four-handed animal than a quadruped. 5. His thighs are shorter than those of man; and, 6, His arms are longer. 7. The testicles are not pendulous. 8. The epiploon is larger than in man. 9. The gall-bladder is longer and narrower. 10. The kidneys are rounder than in man; and the ureters are also different. 11. The bladder is longer. 12. He has no *frænum* to the prepuce. 13. The bone in the orbit of the eye is sunk deeper. 14. He wants the two cavities below the *sella turcica*. 15. The mastoid and styloid processes are extremely small. 16. The bones of the nose are flat. 17. The *vertebræ* of the neck are short, as in the apes, flat before and not round, and their spinal processes are not forked, as in man. 18. He has no spinal process on the first *vertebra* of the neck. 19. He has thirteen ribs on each side, and man has only twelve. 20. The *ossa illia* are perfectly similar to those of the apes, being longer, narrower, and less concave than in man. 21. The following muscles are found in man, and are wanting in the orang-outang, *Occipitales, frontales, dilatatores alarum nasi, seu elevatores labii superioris, interspinalis colli, glutæi minimi, extensor digitorum pedis brevis, et transversalis pedis.* 22. The muscles which appear not in the orang-outang, and are sometimes found in man, are those called *pyrimidales caro musculosa quadrata,* the long tendon and fleshy body of the *palmaris*, the *attolens*, and *retrahens auriculam.* 23. The orang-outang has the *elevator* muscles of the clavicles like those of the apes, and different from those of man. 24. The following are the muscles by which the orang-outang resembles the apes, and differs from man: *Longus colli, pectoralis, latissimus dorsi, glutæus maximus et medius, psoas magnus et parvus, iliacus internus, et gastrocnemius internus.* 25. He differs from man in the figure of the *deltoides, pronator radii teres, et extensor pollicis brevis.*—Anatomy of the orang-outang by Tyson.]

I shall remark, for the better understanding of this description, that the English are not confined, like the French, to a single name to denote *apes.* Like the Greeks they have two denominations, the one for the apes without tails, which they call *apes*, and the other for the apes with tails, which they call *monkeys.* The apes of Tyson could be no other than those which we denominate *pithecus* or *pigmy*, and the *cynocephalus* or Barbary ape. I should likewise remark, that this author gives some resemblances and differences which are not sufficiently accurate.

1. Tyson makes it peculiar to man and the orang-outang, to have the hair on the shoulders directed downward, and that of the arms upward. The hair of most animals, it is true, is directed backward or downward; but there are some exceptions. The sloth and the least ant-eater have the hair of their anterior parts directed backward, and that of the crupper and reins directed forward. Hence this character is of no great moment in the comparison of the orang-outang with man.

2. In the passage quoted from Tyson, I took no notice of the four first differences; because they are either too slight, or ill founded. The first is the difference of stature, which is an uncertain and gratuitous character, especially as the author acknowledges that his animal was very young. The second, third, and fourth are derived from the form of the nose, the quantity of hair, and other minute relations. I retrenched several other differences; for example, the twenty-first, drawn from the number of the teeth. It is certain that both the human species and this animal have an equal number of teeth. If the latter had only twenty-eight, as our author remarks, it was owing to his youth; and it is well known that man when young has not a greater number.

3. The seventh difference is also very equivocal: the testicles of children are situated very high; and this animal, being young, ought not to have had them pendulous.

4. The forty-eighth mark of resemblance, and the

twenty-first, twenty-second, twenty-third, twenty-fourth, and twenty-fifth marks of difference, are derived from the figure or presence of certain muscles, which, as they vary in most individuals of the human species, ought not to be regarded as essential characters.

5. All the resemblances and differences drawn from parts too minute, as the processes of the vertebræ, or derived from the position and magnitude of certain parts, should only be considered as accessory characters; so that the whole detail of Tyson's table may be reduced to the resemblances and differences we have pointed out.

6. I shall mention some characters of a more general nature, some of which have been omitted by Tyson, and others imperfectly related. 1. Of all the apes, baboons, and monkeys, the orang-outang alone wants those pouches within the cheeks, into which they put their food, before they swallow it; for the inside of his mouth is the same as in man. 2. The gibbon, the Barbary ape, all the baboons, and all the monkeys, except the douc, have flat buttocks, with callosities on them. The orang-outang alone has plump buttocks without callosities. The douc likewise has no callosities; but his buttocks are flat and covered with hair; so that, in this respect, the douc forms the shade between the orang-outang and the monkeys. 3. The orang-outang alone has calfs of the legs and fleshy buttocks. This single character shows that he is best formed for walking erect; only his toes are very long, and his heel rests with more difficulty on the ground than that of man. He runs with more ease than he walks; and, to enable him to walk easily and long, he would require artificial heels higher than those of our shoes. 4. Though the orang-outang has thirteen ribs, and man but twelve, this difference does not make him approach nearer to the baboons or monkeys than it removes him from man; because the number of ribs varies in most of those species, some of them having twelve, others eleven, others ten, &c. Hence the only differences between the body of this animal and that of man are reduced to two, namely, the figure of the bones of the pelvis, and the conformation of the feet. These are the only parts worthy of consideration, by which the orang-outang has a greater resemblance to the other apes than he has to man.

From this examination, which I have made with all the exactness I was capable of, a judgment may be formed concerning the orang-outang. If there were a scale by which we could descend from human nature to that of the brutes, and if the essence of this nature consisted entirely in the form of the body, and depended on its organization, the orang-outang would approach nearer to man than any other animal. Placed in the second rank of beings, he would make the other animals feel his superiority, and oblige them to obey him. If the principle of imitation, by which he seems to mimic human actions, were the result of thought, this ape would be still farther removed from the brutes, and have a greater affinity to man. But as we formerly remarked, the interval which separates them is immense; and the resemblance in figure and organization, and the movements of imitation which seem to result from these similarities, neither make him approach the nature of man, nor elevate him above that of the brutes.

Distinctive Characters of this Species.

The orang-outang has no pouches within his cheeks, no tail, and no callosities on his buttocks; which last are plump and fleshy. All his teeth are similar to those of man. His face is flat, naked, and tawny. His ears, hands, feet, breast and belly, are likewise naked. The hair of his head descends on both temples in the form of tresses. He has hair on his back and loins, but in small quantities. He is five or six feet high, and walks always erect on his two feet. We have not been able to ascertain whether the females, like women, are subject to periodical courses; but analogy renders this matter almost unquestionable.

THE PIGMY.

APE with a flattish face; ears like those of a man; body of the size of a cat; colour above an olive brown, beneath yellowish; nails flat; buttocks naked; sits upright.

Aristotle remarks, 'that there are animals whose nature is ambiguous, and are partly allied to man, and 'partly to quadrupeds; such as the *pigmies*, the *kebes*, 'and the *cynocephali*. The *kebe* is a pigmy with a tail; 'and the *cynocephalus* is perfectly similar to the pigmy, 'except that it is larger and stronger, and has a longer 'muzzle, approaching nearly to that of the bull-dog, 'from which circumstance its name has been derived. 'Its manners are likewise more ferocious, and its teeth 'are stronger than those of the pigmy, and have a 'greater resemblance to those of the dog.' From this passage, it is apparent, that neither the pigmy nor the *cynocephalus* mentioned by Aristotle have a tail; for he says, that the pigmies with tails are called *kebes*, and that the *cynocephalus* resembles the pigmy in every article, except the muzzle and teeth. Hence Aristotle takes notice of two apes without tails, the pigmy and *cynocephalus,* and other apes with tails, to which he gives the denomination of *kebes.* Now, to compare our own knowledge with that of Aristotle, we shall remark, that we have seen three species of apes without tails, the orang-outang, the gibbon, or long-armed ape, and the magot, or Barbary-ape, and that the pigmy is none of these three species; for the orang-outang and gibbon could not be known to Aristotle, since these animals are only found in the southern parts of Africa and India, which were not discovered in his time; besides, they have characters very different from those he ascribes to the pigmy. But the third species which we call the *magot,* or Barbary ape, is the *cynocephalus* of Aristotle; for it has no tail; its muzzle resembles that of a bull-dog; and its canine teeth are long and thick. Besides, this animal is common in Asia Minor, and other eastern provinces which were known to the Greeks. The pigmy belongs to the same country; but we know it only from the relations of travellers. But, though we have never been able to procure this ape, its existence is equally real with that of the *cynocephalus.* Gessner and Johnston have given figures of the pigmy. M. Brisson mentions his having seen it, and he distinguishes it from the *cynocephalus* or Barbary ape, which he likewise saw. He confirms Aristotle's remark, that these two animals resemble each other in every thing, except that the *cynocephalus* has a longer muzzle than the pigmy.

[The first race of apes, which have no tail, and a short muzzle: 1. The ape. I saw several apes which differed only in magnitude: their face, ears, and nails, were very similar to those of man. The hair which covered their bodies, except the buttocks, which are naked, is a mixture of green and yellow. The green predominates on the superior part of the body, and the yellow on the inferior. The second race of apes, which have no tail, and a long muzzle: 1. The *cynocephalus* differs from the ape only in having a long muzzle, like that of a dog. I saw several of them which had no difference but in size.—*Brisson.*]

We remarked, that the orang-outang, the pigmy, the gibbon, and the Barbary ape, are the only animals to which the generic name *ape* ought to be applied; because they alone want the tail, and walk spontaneously, and oftener on two feet than on four feet. The orang-outang and the gibbon are very different from the pigmy and Barbary ape. But, as the two latter have a perfect resemblance, except in the length of the muzzle and the largeness of the canine teeth, the one has frequently been mistaken for the other. They have always been mentioned under the common appellation of *ape,* even in languages which have one name for apes without tails, and another for those which have tails. In German, both the pigmy and Barbary ape are called *aff,* and *ape* in English. It is only in the Greek language that each of these animals has a proper name. *Cynocephalus* is rather an adjective than a proper substantive; and for that reason we have not adopted it.

From the testimony of the ancients, it appears, that the pigmy is more mild and docile than all the other apes with which they were acquainted, and that it was common in Asia, as well as in Lybia, and other provinces of Africa which were frequented by the Greek and Roman travellers. Hence I presume that the following passages of Leo Africanus and Marmol ought to be applied to the pigmy. They tell us, that the apes with long tails, which are shown in Mauritania, and which the Africans call *mones,* come from the Negro country; but that the apes without tails are natives, and very numerous in the mountains of Mauritania, Bugia, and Constantina: ‘They have,’ says Marmol, ‘the feet, the hands, and the countenance of a man, ‘and are extremely malicious and full of spirit. They ‘live upon herbs, corn, and all kinds of fruits. They ‘go in troops into the gardens or fields; but, before ‘they leave the thickets, one of them ascends an eminence, from which he views the country; and, when ‘he sees no person, he gives the signal, by a cry for the ‘rest to proceed, and removes not from his station as ‘long as they continue abroad. But whenever he perceives any person approaching, he screams with a loud ‘voice; and, by leaping from tree to tree, they all fly ‘to the mountains. Their flight is worthy of admiration; for the females, though they carry four or five ‘young ones on their backs, make great springs from ‘branch to branch. Though extremely cunning, vast ‘numbers of them are taken by different arts. When ‘wild, they bite desperately; but by caresses they are ‘easily tamed. They do much mischief to the fruits ‘and corn; for they gather it together in heaps, cut it, ‘and throw it on the ground, whether it be ripe or not, ‘and destroy more than they eat or carry off. Those ‘who are tamed perform things which are almost ‘incredible, and imitate every human action.’ Kolbe relates nearly the same facts with regard to the apes of the Cape of Good Hope. But, from his figure and description, it is obvious, that these apes are baboons, and have a short tail, a long muzzle, pointed nails, &c.; and that they are much larger and stronger than the apes of Mauritania. We may therefore presume, that Kolbe has copied the passage from Marmol, and attributed to the baboons of the Cape the manners and dispositions of Mauritanian pigmies.

The pigmy, the Barbary ape, and the baboon were known to the ancients; these animals are found in Asia Minor, Arabia, Upper Egypt, and in all the northern parts of Africa. Hence this passage of Marmol may be applied to all the three. But it corresponds not with the baboon; for it mentions that these apes have no tails. Neither is it the Barbary ape, but the pigmy, of which this author treats; for the Barbary ape is not easily tamed, and instead of four or five it generally produces only two young. But the pigmy, being smaller, should produce a greater number. Besides, it is milder and more docile than the Barbary ape, which is never perfectly tamed. For these reasons I am convinced that it is not the Barbary ape but the pigmy, to which the passage in the above author ought to be applied. The same remark is applicable to a passage of Rubruquis; when mentioning the apes of Cathay, he says, 'That in 'every article they are fashioned like man. That they 'are more than a foot and a half high, and all covered 'with hair; that they live in caverns; that in order to 'seize them the natives put strong inebriating liquors 'in the caverns they frequent; that they assemble together to drink these liquors, crying *chinchin*, from 'which they have obtained the name of *chinchin;* and 'that after intoxicating themselves they fall asleep, when 'they are easily taken by the hunters.' These characters correspond with the pigmy, and by no means with the Barbary ape. The latter we have seen alive, and never heard it cry *chinchin.* Besides, it is much more than a foot and a half high, and has not so great a resemblance to man as the author alledges. We have the same reasons for applying to the pigmy the figure and remark of Prosper Alpinus. He tells us, that the small apes without tails, which he saw in Egypt, tame sooner and more easily than any other; that they have likewise more sagacity and industry, and are gayer and more frolicsome. Now the Barbary ape is thick, and of a considerable stature; it is a dirty, ferocious, melancholy animal, and is never fully tamed. Hence the characters given by Prosper Alpinus to his ape without a tail apply not to the Barbary ape, and can belong to no other animal than the pigmy.

Distinctive Characters of this Species.

The pigmy has no tail, and his canine teeth are not proportionally larger than those of man. He has a flat face; his nails are likewise flat, and rounded like those of the human species. He walks on two feet, and is about a foot and a half in length. His disposition is mild, and he is easily tamed. The ancients alledge that the female is subject to the menstrual discharge, and analogy permits us not to doubt the fact.

THE GIBBON, OR LONG-ARMED APE.

LONG-armed ape, with a flat swarthy face, surrounded with gray hairs; hair on the body black and rough; buttocks bare; nails on the hands flat, on the feet long; arms of a disproportioned length, reaching quite to the ground when the animal is erect, its natural posture; of a hideous deformity.

Gibbon is the name under which M. Duplex gave us this animal, which he brought from the East Indies. I first imagined this to be an Indian word. But I found in a note upon Pliny by Dalecamp, that Strabo had denoted the *cephus* by the words *keipon,* from which *guibon* or *gibbon* had probably been derived.

The gibbon keeps himself always erect, even when he walks on four feet; because his arms are as long as both his body and legs. We have seen him alive. He exceeded not three feet in height; but he was young and in captivity. Hence we may presume, that he had not acquired his full dimensions, and that in a natural state he might arrive at four feet. He has not the vestige of a tail. But he is distinguished from the other apes by the prodigious length of his arms: when standing erect on his hind feet his hands touch the ground: and he can walk on his four feet without bending his body. Round the face there is a circle of white, which gives him a very extraordinary appearance. His eyes are large, but deep sunk. His ears are naked. His face is flat, of a tawny colour, and pretty similar to that of man. After the orang-outang and the pigmy the gibbon would make the nearest approach to the human figure, if he was not deformed by the excessive length of his arms; for in a state of nature man would likewise have a strange aspect. The hair and the beard, if neglected, would form round his countenance a circle similar to that which surrounds the face of the gibbon.

This ape appeared to be of a tranquil disposition and of gentle manners. His movements were neither too brisk nor precipitant. He received mildly what was given him to eat. He was fed with bread, fruit, almonds, &c. He was afraid of cold and moisture, and did not live long in a foreign climate. He is a native of the East Indies, and particularly of Coromandel, Malacca, and the Molucca islands. It appears that he is likewise found in more northern provinces, and that we ought to refer to the gibbon the ape of the kingdom of Gannaura on the frontier of China, to which some travellers have given the name of *fefe.*

[Father le Comte tells us, that he saw in the Moluccas a kind of ape, which walked naturally on two feet, used its hands like a man, and had a face like that of a Hottentot. But the whole body was covered with a kind of gray wool. It had an exact resemblance to an infant, and expressed its passions and appetites in the most perfect manner. He adds, that these apes are extremely gentle; that they show great attachment to the people with whom they are acquainted, and embrace them with transport; that one of them which he saw was at least four feet high, and was very dexterous and agile.—*Mem. sur la China.*

In the kingdom of Gannaura, on the frontier of China, there is a very rare animal called *fefe*. It is nearly of the human figure. Its arms are very long; the body is black, and covered with hair; and it moves lightly and very quick.—*Recueil des Voyages. Note*—1. This character of very long arms belongs only to the gibbon; and consequently indicates, that the fefe is the same animal. 2. We may presume, that the word *fefe* comes from *jefef* or *sesef;* the name of the baboon in the provinces of Africa which border upon Arabia, and that it has been transferred from the baboon to the gibbon; for the arms of the baboon are not longer than those of the other apes.]

The gibbon varies in size and colour. There are two in the royal cabinet, of which the second, though an adult, is much smaller than the first, and is brown on all the parts where the other is black. But they so perfectly resemble each other in every other article, that they unquestionably belong to the same species.

Distinctive Characters of this Species.

The gibbon has no tail. There are slight callosities on his buttocks. His face is flat, brown, and surrounded with a circle of gray hairs. His canine teeth are proportionally larger than those of man. The ears are naked, black, and round. The arms are enormously long. He walks on his two hind feet, and is about a foot and a half or three feet high. The female, like women, is subject to a periodical evacuation.

THE MAGOT, OR BARBARY APE.

BARBARY ape with a long face, not unlike that of a dog; canine teeth long and strong; ears like the human; nails flat; buttocks bare; colour of the upper part of the body a dirty greenish brown; belly of a dull pale yellow; grows to above the length of four feet.

It is certain that this ape has no tail, though there is a slight appearance of one, formed by a small appendix of skin about half an inch long, and situated above the anus. But this appendix has no vertebræ, and is only a portion of skin which adheres not more to the coccix than to the rest of the skin.

Of all the apes without tails the magot agrees best with the temperature of our climate. We kept one several years. In summer he delighted to be in the open air; and in winter he might be kept in a room without fire. Though by no means delicate, he was always melancholy, and sometimes dirty. He used the same grimaces to mark his anger, or to express his appetite. His movements were brisk, his manners gross, and his aspect more ugly than ridiculous. When agitated with passion he exhibited and ground his teeth. He filled the pouches of his cheeks with the food which was given him, and generally eat every thing except raw flesh, cheese, and whatever had undergone a kind of fermentation. When about to sleep he loved to perch upon an iron or wooden bar. He was always chained; because though he had been long in a domestic state he was not civilised, and had no attachment to his masters. He seems to have been ill-educated; for I have seen others of the same species more intelligent, more obedient, more gay, and so docile as to learn to dance, to make gesticulations in cadence, and to allow themselves peaceably to be clothed.

This ape, when erect upon his two hind legs, is generally two feet and a half, or three feet high; the female is smaller than the male. He walks more willingly on four than on two feet. When resting he commonly supports his body on two prominent callosities, which are situated where the buttocks ought to be: the anus is placed higher. Hence his body is more inclined than that of a man when sitting. He differs from the pigmy or ape properly so called: 1. Because his muzzle is thick and long, as in the dog; but the face of the pigmy is flat; 2. Because he has very long canine teeth; 3. Because his nails and fingers are neither so flat nor so round; and, 4. Because he is larger, more squat, and of a more ferocious and untractable disposition.

There are some varieties in this species. We have seen magots of different sizes, and with hair more or less deeply coloured, and more or less bushy. It even appears, that the five animals described and drawn by Prosper Alpinus, under the denomination of *cynocephali*, are all magots, which differ only in magnitude, and in some other characters too slight to constitute distinct species. It likewise appears that the species is pretty generally diffused over all the warm climates of the Old Continent, and that they are found in Tartary, Arabia, Æthiopia, Malabar, Barbary, Mauritania, and as far as the Cape of Good Hope.

[The third species of Malabarian ape is ash-coloured, and has no tail, or a very short one. It is familiar, and easily apprehends what it is taught. I received one in a present, and I once thought proper to beat it; but its cries brought about me such a number of its neighbours in a wild state, that to prevent accidents I restored it to liberty.—*P. Vincent Marie.*

It is probably this species of ape, which Robert Lade mentions in the following terms: 'We traversed a large mountain in the neighbourhood of the Cape of Good Hope, and amused ourselves with hunting large apes, which are very numerous in that place. I can neither describe all the arts practised by these animals, nor the nimbleness and impudence with which they returned after being pursued by us. Sometimes they allowed us to approach so near them that I was almost certain of seizing them. But when I made the attempt, they sprung at a single leap ten paces from me, and mounted trees with equal agility, from which they looked at us with great indifference, and seemed to derive pleasure from our astonishment. Some of them were so large, that if our interpreter had not assured us that they were neither ferocious nor dangerous, our number would not have appeared to be sufficient to protect us from their attacks. As it could serve no purpose to kill them we did not use our guns. But the captain happened to aim at a very large one which sat on the top of a tree, after having fatigued us a long time in pursuing him: this kind of menace, however, of which the animal perhaps recollected his having sometimes seen the consequences, terrified him to such a degree, that he fell down motionless at our feet, and we had no difficulty in seizing him. But whenever he recovered from his stupor it required all our dexterity and efforts to keep him. We tied his pats together. But he bit so furiously that we were under the necessity of covering his head with our handkerchiefs.'—*Voyages by Robert Lade.*]

Distinctive Characters of this Species.

The magot has no tail, though there is a small portion of skin which has the appearance of one. He has cheek pouches, large prominent callosities on his buttocks, canine teeth, proportionally longer than those of man, and the under part of the face turned up, like the muzzle of a bull-dog. He has down on his face; the hair on his body is a greenish brown colour, and that on his belly is of a whitish yellow. He walks on the two hind feet, but oftener on four. He is three or three and a half feet high; and some of this species appear to be still larger. The females are subject to a periodical discharge.

THE BABOON, properly so called.

In man the physiognomy is deceitful, and the figure of his body gives no indication of the qualities of his mind. But in the brute creation we may judge of the disposition by the aspect; for every internal quality appears externally. For example, in looking at the apes and baboons, it is easy to perceive, that the latter ought to be the most savage, and mischievous. Their manners differ as much as their figures. The orang-outang has the greatest resemblance to man; and he is the most grave, docile, and intelligent of the whole race. The Barbary ape, which begins to recede from the human figure, and approaches to that of the brutes by his muzzle and canine teeth, is brisk, disobedient, and nasty. The baboons, who resemble man in the hands only, and who have a tail, sharp nails, a large muzzle, &c. have the air of ferocious beasts, which they really are. The baboon, of which a figure is here given, I saw alive. He was not perfectly hideous; and yet he excited a degree of horror. Perpetually grinding his teeth, fretting and chafing with rage, his owner was obliged to keep him confined in an iron cage, the bars of which he moved so powerfully with his hands that he inspired the spectators with terror. He is a squat animal, whose compact body and nervous members indicate strength and agility. He is covered with long close hair, which gives him the appearance of being larger than he is in reality. His strength, however, is so great, that he would easily overcome one or several men, if not provided with arms. Besides, he is continually agitated by that passion which renders the gentlest animals ferocious. He is insolently salacious, affects to show himself in this situation, and seems to gratify his desires *per manum suam*, before the whole world. This detestable action recalls the idea of vice, and renders disgustful the aspect of an animal, which Nature seems to have particularly devoted to such an uncommon species of impudence; for, in all other animals, and even in man, she has covered these parts with a veil. In the baboon, on the contrary, they are perpetually naked, and the more conspicuous, because the rest of the body is covered with long hair. The buttocks are likewise naked, and of a blood red colour; the testicles are pendulous; the anus is uncovered, and the tail always elevated. He seems to be proud of all those nudities; for he presents his hind parts more frequently than his front, especially when he sees women, before whom he displays an effrontery so matchless, that it can originate from nothing but the most inordinate desire. The magot, and some others, have the same inclinations; but as they are smaller and not so petulant, they are taught modesty by the whip. The baboon, however, is perfectly incorrigible, and nothing can tame him.

[It is to this species that the animal called *tre, tre, tre, tre*, at Madagascar, ought to be referred. It is as large, says Flacourt, as a calf of two years old. It has a round head, and the face of a man. The fore and hind feet are like those of the ape. The hair is crisped, the tail short, and the ears resemble those of a man. It is similar to the *tanach* described by Ambrose Pary. It is a solitary animal, and much dreaded by the natives.—*Voyage a Madagascar.*]

Notwithstanding the violence of their passion, these animals produce not in temperate climates. The female generally brings forth but one young at a time, which she carries between her arms, in a manner fixed to her pap. Like women, she is subject to a periodical evacuation, which is common to her with the other female apes who have naked buttocks. These baboons, though mischievous and fierce, are not carnivorous. They live chiefly on fruits, roots, and seeds. They assemble in troops for the purpose of robbing gardens; they throw the fruit from hand to hand, and over the walls; and they make great havock in all the cultivated lands.

[The baboons are passionately fond of raisins, apples, and in general, of all fruits which grow in gardens. Their teeth and paws render them formidable to dogs, who overcome them with difficulty, unless when excess of eating has made them heavy and inactive.—I remarked that they neither eat fish nor flesh, except when boiled or roasted, and then they devour both with avidity.—In their expeditions to rob orchards, gardens, or vineyards, they generally go in troops. Some of them enter the inclosure, while others remain on the wall as sentinels, to give notice of any approaching danger. The rest of the troop are stationed without the garden, at convenient distances from each other, and thus form a line which extends from the place of pillage to that of their rendezvous. Matters being disposed in this manner, the baboons begin the operation; and throw to those on the wall, melons, gourds, apples, pears, &c. Those on the walls throw these fruits to their neighbours below; and thus the spoils are handed along the whole line, which generally terminates on some mountain. They are so dexterous, and quick-sighted, that they seldom allow the fruit to fall in throwing it from one to another. All this is performed with profound silence and great dispatch. When the sentinels perceive any person, they cry; and, at this signal, the whole troop fly off with astonishing rapidity.—*Kolbe.*]

Distinctive Characters of this Species.

The baboon has cheek-pouches and large callosities on his buttocks, which are naked, and of a blood colour. His tail is arched, and about seven or eight inches long. The canine teeth are proportionally much longer and larger than those of man. The muzzle is very thick and long; the ears are naked; the body is massy and contracted; the members are thick and short; the organs of generation are naked and flesh-coloured. The hair is long, bushy, of a reddish brown, and pretty uniform over the whole body. He walks oftener on four than on two feet. When erect, he is three or four feet high. In this species there seem to be races still larger, and others much smaller. We have given figures both of the large and small kinds, in which we can perceive no other difference than that of magnitude. This difference however proceeds not from age; for the small baboon appeared to be an adult as well as the large. The females are subject to the menstrual discharge.

[In August 1779, a male baboon, remarkable for its magnitude, strength, and beautiful colours, was exhibited at Edinburgh. It was generally thought to be a variety of the mandrill described by Gessner, Buffon, Ray, Linnæus, and Brisson. But as it differed from the mandrill of these authors in a number of characters, the Translator caused a drawing of it to be made. The mandrill is said not to exceed two feet in length. But this baboon, when erect, was near five feet high. The mandrill is represented as a good-natured, though not a sportive animal. This baboon, on the contrary, was excessively fierce, presented uniformly to the spectators the most threatening aspect, and attempted to seize every person who came within reach of his chain. On such occasions, he made a deep grunting noise, and tossed up his head almost perpetually. The baboon described by Buffon 'presented his hind parts more 'frequently than his front, especially when he saw wo-'men.' But this baboon uniformly presented his face, and allowed no person to approach him behind. The Count de Buffon remarks, that the mandrill is an animal of the most disgusting deformity, and that he perpetually licks a snot which runs from his nose. But the baboon under consideration was an animal of great beauty, and had no visible distillation from his nostrils.

Since writing the above, Mr. Pennant obligingly communicated to the Translator the proof sheets of a new and elegant edition of his excellent Synopsis of Quadrupeds, in which is contained the following accurate description of this animal, under the appellation of the *Great Baboon.*

GREAT BABOON.

'Baboon with hazel irides; ears small and naked; 'face canine, and very thick; middle of the face and 'forehead naked, and of a bright vermilion colour; tip 'of the nose of the same; it ended truncated like that 'of a hog: sides of the nose broadly ribbed, and of a 'fine violet blue; the opening of the mouth small; 'checks, throat, and goat-like beard, yellow: hair on 'the forehead is very long, turns back, is black, and 'forms a kind of pointed crest. Head, arms, and legs, 'covered with short hair, yellow and black intermixed; 'the breast with long, whitish, yellow hairs; the shoul'ders with long brown hair.

'Nails flat; feet and hands black: tail four inches 'long, and very hairy: buttocks bare, red, and filthy; 'but the space about them is of a most elegant purple 'colour, which reaches to the inside of the upper part 'of the thighs.

'This was described from a stuffed specimen in Sir 'Ashton Lever's museum. In October 1779, a live 'animal of this species was shown at Chester, which 'differed a little in colour from the above, being in ge'neral much darker. Eyes much sunk in the head, and 'small. On the internal side of each ear was a white 'line, pointing upwards. The hair on the forehead 'turned up, like a toupée. Feet black; in other respects 'resembled the former.

'In this I had an opportunity of examining the teeth. 'The cutting teeth were like those of the rest of the 'genus; but in the upper and lower jaw, were two 'canine, or rather tusks, near three inches long, and 'exceedingly sharp and pointed.

'This animal was five feet high, of a most tremen'dous strength in all its parts; was excessively fierce, 'libidinous, and strong.

'Mr. Schreber says, that this species lives on suc'culent fruits, and on nuts; is very fond of eggs, and 'will put eight at once into its pouches, and, taking 'them out one by one, break them at the end, and swallow 'the yolk and white: rejects all flesh-meat, unless it be 'dressed: would drink quantities of wine or brandy: 'was less agile than other baboons: very cleanly; for it 'would immediately fling its excrements out of its hut.

'That which was shown at Chester was particularly 'fond of cheese. Its voice was a kind of roar, not 'unlike that of a lion, but low and somewhat inward. 'It went upon all fours, and never stood on its hind 'legs, unless forced by the keeper; but would fre'quently sit on its rump in a crouching manner, and 'drop its arms before the belly.'

To this description very little can be added. In the individual shown at Edinburgh, which was probably the same that Mr. Pennant afterwards saw at Chester, the colours of the face were distinct and unmixed. The ribbed cheeks were of a sky-blue colour. A vermilion line began a little above the eyes, and running down between them, and on each side of the nose, spread over the snout. The inside of the ears was blue, which, softening from purple, terminated in vermilion. The beard, at the roots, was of the same dark brown colour with that of the upper part of the body; but it soon changed into a deep orange, and ended in yellow. The hairs on the belly were of an ash-colour, and speckled like the sides of a partridge. The rump was of a vermilion colour; and the beautiful colours on the hips were only gradations from red to blue. If it had any callosities on the buttocks, they were not apparent. The penis was nearly of the same red colour with the rump; that of the testicles was more fiery, and softened into a light blue, which likewise spread over the inside of the thighs.—It was very fond of the ears of wheat, the grains of which it dexterously picked out, one by one, with its teeth.

THE MANDRILL, OR RIBBED NOSE BABOON.

RIBBED nose baboon, with a long naked nose compressed sidewise, of a purple colour, and ribbed obliquely on each side; on the chin, a short picked orange beard; tail very hairy, about two inches long, which it carries erect; buttocks naked; hair soft, dusky mottled with yellow; length, from nose to tail, about two feet.

The ugliness of this baboon is perfectly disgusting. His nose, or rather his two nostrils, are flat, from which a snot perpetually runs, and he licks it into his mouth with his tongue. His head is very large, and his muzzle long. His body is squat, and his buttocks are of a blood colour. His anus is conspicuous, and situated almost as high as the loins. His face is of a violet colour, and surrounded on each side with deep longitudinal wrinkles, which augment the sullenness and deformity of his aspect. He is likewise larger, and perhaps stronger than the baboon; but, at the same time, he is more peaceable, and less ferocious. We here give figures of both the male and the female, which we have seen alive. Whether they had received a better education, or if they be naturally more gentle than the baboon, they appeared to be more tractable and less impudent; but they were equally disagreeable.

This species of baboon is found on the Gold Coast, and in the other southern provinces of Africa, where he is called *boggo* by the Negroes, and *mandrill* by the Europeans. Next to the orang-outang, he is the largest of all the apes or baboons. Smith relates, that he had a present of a female mandrill, which was only six months old, and that it was as large as an adult baboon. He adds, that these mandrills walk always on two feet; that they weep and groan like men; that they have a violent passion for women, which they never fail to gratify when they find a woman at a distance from relief.

[The body of the mandrill when full grown is as big in circumference as a middle-sized man's. His legs are much shorter, and his feet longer, his arms and hands in proportion. The head is monstrously big, and the face broad and flat, without any other hair but the eyebrows; the nose very small, the mouth wide, and the lips thin. The face, which is covered by a white skin, is extremely ugly, being all over wrinkled as with old age; the teeth broad and very yellow; the hands have no more hair than the face, but the same white skin, though all the rest of the body is covered with long black hair like a bear. They never go upon all four like apes, but cry when vexed or teazed, just like children. It is said that the males often attack and use violence to the black women, wherever they meet them alone in the woods. They are generally very snotty-nosed, and take great delight in scraping it down from their noses to their mouths. When I was at Skerbro one Mr. Cummerbus made me a present of one of these strange animals, which are called by the natives *boggoe.* It was a she-cub of six months of age, but was then larger than a baboon.—*Smith.*

In the same country this animal is called *boogoo* or *boggo*, and *mandrill*, and they likewise call the orang-outang *pongo* and *drill.* There is much similarity in these names, and they are probably derived from each other: and, in fact, the pongo and boggo, or the drill and mandrill have several common characters. But the first is an ape without a tail, almost naked, and with a flat oval face; and the second is a baboon with a tail, long hair, and a thick and long muzzle. *Man,* in the German and English languages, signifies man in general; and *drill* in the jargon of some of our French provinces denotes a vigorous libertine.]

Distinctive Characters of this Species.

The mandrill has cheek pouches, and callosities on the buttocks. The tail exceeds not two or three inches. The canine teeth are much thicker and longer than those of man. The muzzle is very thick, very long, and furrowed on each side with deep longitudinal wrinkles. The face is naked, and of a bluish colour. The ears, as well as the palm of the hands and soles of the feet, are naked. The hair is long, of a reddish brown upon the body, and gray upon the breast and belly. He walks on two feet oftener than on four. When erect he is four or four and a half feet high; and some of them seem to be still larger. The females are subject to the *menses.*

THE OUANDEROU, AND THE LOWANDO.

THOUGH these two animals appear to belong to the same species we have preserved to each of them the proper names they receive in Ceylon, which is their native country; because they constitute at least two distinct and permanent races. The body of the ouanderou is covered with brown and black hairs; it has a bushy head and a large beard. The body of the lowando, on the contrary, is covered with whitish hairs, and the hair on its head and beard is black. In the same country there is a third race or variety, which is probably the common stock of the other two; for the hair on its body, head, and beard, is of one uniform white colour. These three animals are not apes, but baboons, of which they have all the characters both in figure and dispositions. They are wild, and even ferocious. Their muzzle is long, their tail short, and they are nearly of the same size and strength as the baboons. Their bodies are indeed less squat, and their hind parts seem to be more feeble. That of which we have given a figure was exhibited to us under false appellations, both with regard to its name and climate. Its owners told us, that it came from the continent of America, and that it was called *cayouvassou.* I soon recollected that this word *cayouvassou* is a Brasilian term, which is pronounced *sajououssou*, and signifies *sapajou;* and consequently that it was improperly applied; since all the sapajous have very long tails. But the animal under consideration is a baboon with a very short tail. Besides, not a single species of baboon exists in America. Errors with regard to climate are very common, especially among those who exhibit wild beasts: when they are ignorant of the climate and the name of an animal, they fail not to give it a foreign denomination, which, whether true or false, equally serves their purpose.

These baboon-ouanderous, when not tamed are so mischievous, that they must be kept in iron cages, where they are frequently agitated with vast fury. But when taken young they are easily tamed, and appear to be even more susceptible of education than the other baboons. The Indians delight in instructing these animals, and pretend that the other apes, that is, the monkeys have a great respect for the baboons, who are possessed of more gravity and intelligence. In a state of liberty they are extremely wild, and keep perpetually in the woods. If we may credit travellers, those which are all white are strongest and most mischievous. They are violently fond of women, strong enough to ravish them when found alone, and often injure them so as to prove fatal.

[In Malabar we find four species of apes: the first is all black and lustrous, with a white beard, which surrounds its chin, and is more than a palm in length. The other apes have such a respect for this species that they humble themselves in its presence as if they were conscious of its superiority. The princes and nobles esteem these bearded apes; because they appear to have more gravity and intelligence than the other kinds. They are educated for ceremonies and sports, in which they acquit themselves to the admiration of the spectators.—*Le Pere Vincent Marie.*

In Ceylon there are monkeys as large as our spaniels. They have gray hair, a black visage, and a white beard which extends from the one ear to the other. We meet with others of the same size, but of a different colour. This difference in colour appears not to alter the species, for they equally receive the denomination of *ouanderous.* They do little injury to the cultivated lands, and generally remain in the woods, where they live upon leaves and buds; but when taken they eat any thing.—*Knox.*

The white apes, which are sometimes of the size of the largest bull dogs, are more dangerous than the black. They have a great desire for women, and after committing many outrages on them, terminate the scene by strangling them. They sometimes come to the very houses; but the natives of Macacar, who are extremely jealous of their wives, take care to prevent the admission of such hideous gallants.—*Descript. de Macacar.*]

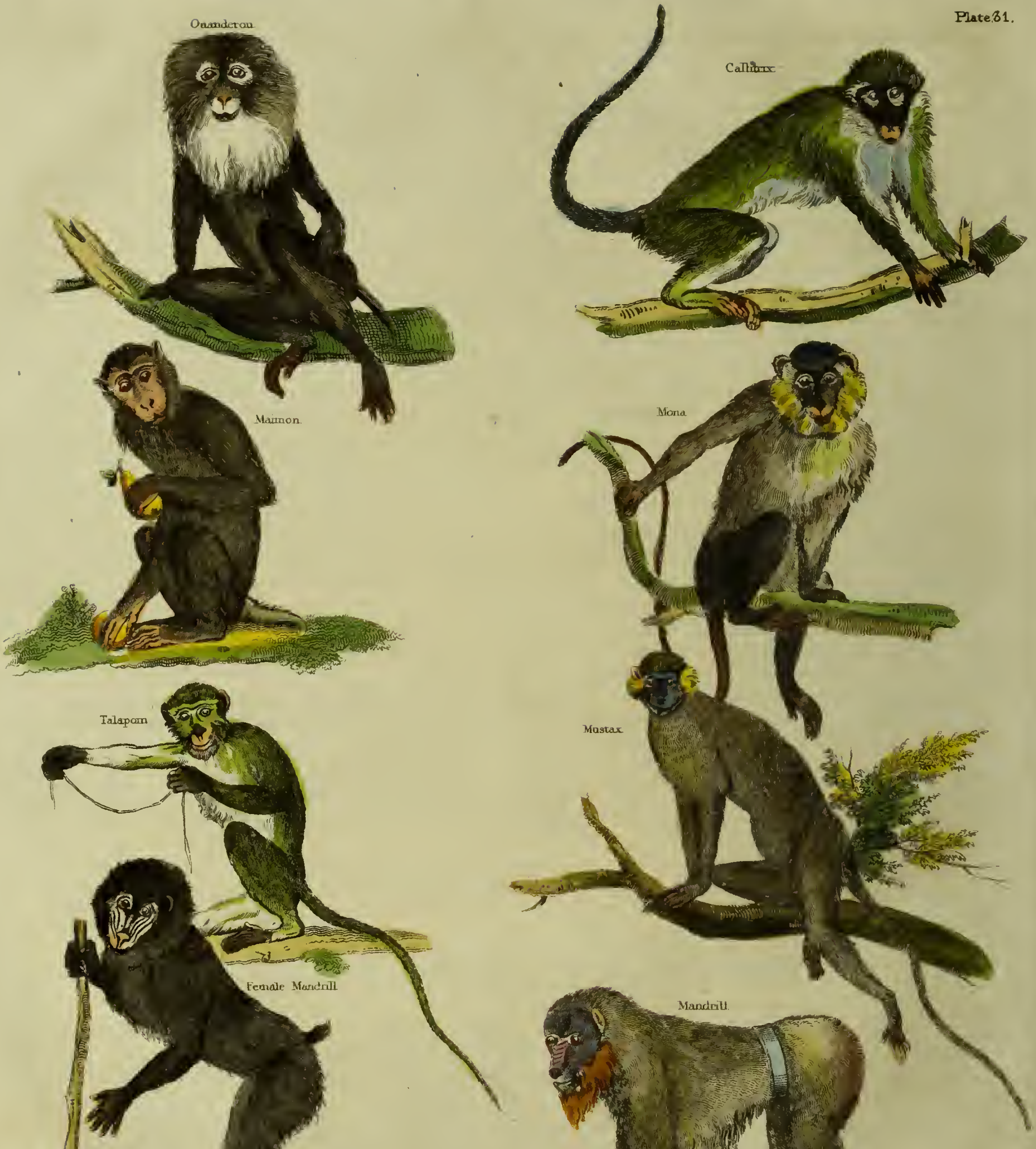
Distinctive Characters of this Species.

The ouanderou has cheek-pouches, and callosities on the buttocks. The tail is seven or eight inches in length. The canine teeth are longer and larger than those of man. The muzzle is thick and long. The head is environed with a broad mane, and a large beard of coarse hairs. The body is pretty long, and thin behind. In this species there are races which vary in colour. Some have the hair on the body black, and a white beard; in others the hair on the body is whitish, and the beard black. They walk more frequently on four than on two feet; and when erect they are three or three and a half feet high. The females are subject to the periodical evacuation.

THE MAIMON, OR PIG-TAILED BABOON.

PIG-TAILED baboon, with a pointed face; eyes hazel; above and beneath the mouth some few black hairs; face naked of a swarthy redness; two sharp canine teeth; ears like the human; crown of the head dusky; hair on the limbs and body brown, inclining to ash-colour; palest on the belly; fingers black; nails long and flat; thumbs on the hind feet very long, connected to the nearest toe by a broad membrane; tail four inches long, exactly like a pig's, and almost naked; the bare spaces on the rump red, and but small; length from head to tail twenty-two inches.

The apes, baboons, and monkeys, form three tribes, with intervals between each, the first of which is filled by the magot, and the second by the maimon. The latter constitutes the link or shade between the baboons and monkeys, as the magot does between the apes and baboons. In effect the maimon resembles the baboons by the thickness and largeness of his muzzle, and by his short arched tail; but he differs from them, and approaches the monkeys by the smallness of his size, and the mildness of his nature. Mr. Edwards has given a figure and description of the maimon under the denomination of the *pig-tailed ape.* This peculiar character is sufficient to distinguish him; for of all the baboons or monkeys, he alone has a naked, slender, and arched tail, like that of a pig. He is nearly of the size of the magot,



Lond. Published by Rob^d Evans White Row, Smithfields 1816.

and has so strong a resemblance to the macaque, or hare-lipped monkey, that he might be regarded as a variety of this species, if his tail were not totally different. He has a naked, tawny face, chesnut coloured eyes, black eye-lids, a flat nose, and thin lips, with some stiff hairs, but too short to form whiskers. He has not, like the apes and baboons, his testicles and penis prominent and apparent; the whole organs are concealed under the skin. Hence the maimon, though vivacious and full of fire, has none of that impudent petulance peculiar to the baboons. He is gentle, tractable, and even caressing. He is found in Sumatra, and probably in other southern provinces of India; of course he endures with difficulty the cold of our climate. The one we saw in Paris lived a short time only, and that which Mr. Edwards described, existed only twelve months in London.

[The pig-tailed monkey, from the island of Sumatra, in the Indian Sea, was brought to England in the year 1752. It was extremely lively and full of action. It was about the bigness of a common house-cat. It was a male. But, since I purchased this, which lived a year with me, I have seen a female of the same species shown in Bartholomew fair, London. It was larger by half than mine, which I carried to compare with it. They seemed highly pleased with each other's company, though it was the first time of their meeting.—*Edwards's Gleanings.*]

Distinctive Characters of this Species.

The maimon has cheek-pouches, callosities on the buttocks, and a naked, curled up tail from five to six inches in length. The canine teeth are not proportionally longer than those of man. The muzzle is very large; the orbits of the eyes are prominent above; the face, the ears, the hands, and the feet are naked and flesh-coloured. The hair on the body is of an olive black colour, and of a reddish yellow on the belly. He sometimes walks on two, and sometimes on four feet. When erect, he is two feet, or two feet and a half high. The female is subject to the menstrual flux.

THE MACAQUE OR HARE-LIPPED MONKEY, AND THE EGRET.

HARE-LIPPED monkey, with the nostrils divided like those of a hare; nose thick, flat and wrinkled; head large; eyes small; teeth very white; body thick and clumsy; buttocks naked; tail long; colour varies, sometimes like that of a wolf, but others are brown, tinged with yellow or olive. The tail is rather shorter than the body, and is always carried arched.

The egret monkey, with a long face, and an upright sharp-pointed tuft on the top of the head; hare on the forehead black; the tuft and upper part of the body light gray; eye-brows large; beard small. It is of the size of a small cat.

Of all the *guenons,* or monkeys with long tails, the macaque makes the nearest approach to the baboons. Like them, his body is short and squat, his head and muzzle large, his nose flat, his cheeks wrinkled, and, at the same time, he exceeds most of the other monkeys in size. He is also extremely ugly; so that he might be regarded as a small species of baboon, if his tail were not long and bushy, while that of the baboons in general is very short. This species is a native of Congo, and other southern provinces of Africa. It is numerous, and subject to several varieties in size, in colour, and in the disposition of the hair. The body of that described by Hasselquist was more than two feet long; and those we have seen exceed not a foot and a half. The one we have denominated *egret,* because it has a crest or tuft of hair on the top of the head, appears to be only a variety of the macaque, which it resembles in every article, except this and some other slight differences in the hair. They are both of mild manners, and extremely tractable. But, independent of a disagreeable musky odour which they both diffuse, they are so dirty, so ugly, and so loathsome, that, when they make their grimaces, they cannot be viewed without horror and disgust. These monkeys go often in troops, especially in their expeditions to rob gardens. Bosman relates, that they take in each paw a quantity of millet, and an equal quantity under their arms and in their mouths; that they return thus loaded leaping on their hind feet, and, when pursued, they drop the stalks which they held under their arms and in their hands, preserving only what they carry in their teeth, to enable them to run with more speed on their four feet. He adds, that they examine, with the most scrupulous accuracy, every stalk of millet they pull, and, if it does not please them, they throw it on the ground, and tear up others. By this delicacy of choice, they do more damage than by their robberies.

Distinctive Characters of this Species.

The macaque has cheek-pouches, and callosities on his buttocks. His tail is from eighteen to twenty inches long. His head is large, his muzzle very thick, and his face naked, livid, and wrinkled. His ears are covered with hair. His body is short and squat, and his limbs thick and short. The hair on the superior parts of his body is of a greenish ash-colour, and of a yellowish gray on the breast and belly. He has a small crest of hair on the top of the head. He walks on four and sometimes on two feet. The length of his body, comprehending that of the head, is about eighteen or twenty inches. In this species, there appear to be races much larger, and others much smaller, such as that of the following.

The egret seems to be only a variety of the macaque: he is about one-third less in all his dimensions. Instead of a small crest of hair on the top of the head, as in the macaque, the egret has an erect pointed tuft. The hair on his front is black; but that on the front of the macaque is greenish. The tail of the egret is likewise proportionally larger than that of the macaque. The females of both kinds have periodic evacuations.

THE PATAS, OR RED MONKEY.

RED monkey with a long nose; eyes sunk in the head; ears furnished with pretty long hairs; body slender: over each eye, from ear to ear, extends a black line: the upper part of the body of a most beautiful and bright bay, almost red, so vivid as to appear painted; the lower parts ash-colour, tinged with yellow. The tail is not so long as the body, the length of which is about one foot six inches.

The patas belong to the same country, and is nearly of the same size with the macaque; but his body is longer, his face less hideous, and his hair more beautiful. He is remarkable for the brilliancy of his robe, which is of so vivid a red as to have the appearance of being painted. We have seen two varieties of this species. The first has a black line above the eyes, which extends from ear to ear. The second differs from the first only in the colour of this line which is white. Both have long hair under the chin and round the cheeks, which makes a fine beard: but in the first it is yellow, and in the second white. This variety seems to indicate others in the colour of the hair; and I am inclined to think, that the monkey mentioned by Marmol, which is of the colour of a wild cat, and said to come from the Negro country, is a variety of the patas.

These monkeys are not equally dexterous as the other kinds; and at the same time they are extremely inquisitive. 'I have seen them,' says Brue, 'descend from 'the tops of the trees to the extremities of the branches, 'in order to admire the barks as they passed. They stare 'for some time, seem to be entertained with what they 'have seen, and then give place to those who come after. 'They became so familiar as to throw branches at the 'Frenchmen, who returned the compliment by the shot 'of their muskets. Some of them fell, others were 'wounded, and the rest were struck with a strange con'sternation. One party raised hideous cries; another 'collected stones to throw at the enemy: some of them, 'with their bowels in their hands, attempted to throw 'their entrails at the spectators. At last, perceiving the 'combat to be at least equal, they retired.'

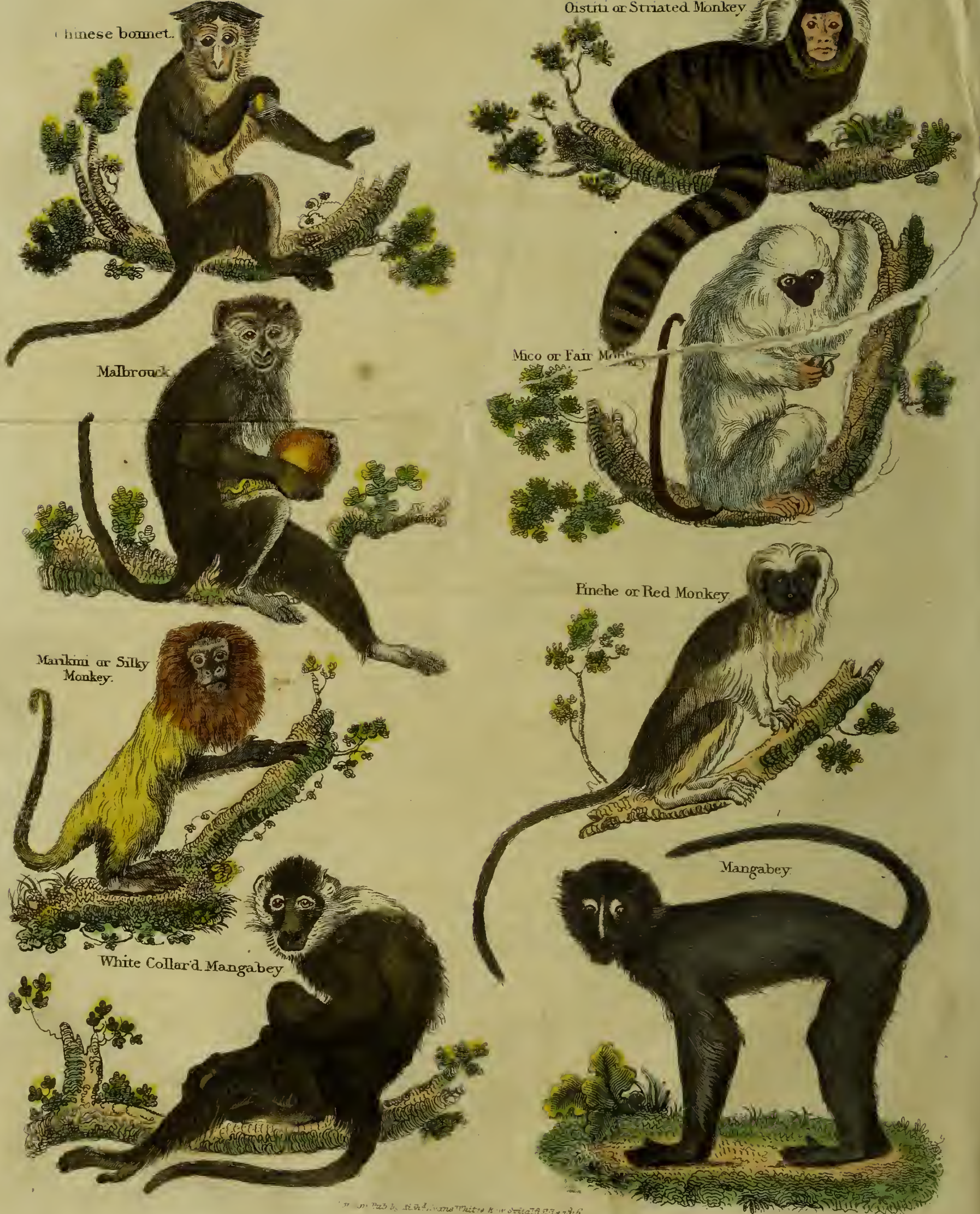
It is probably this species of monkey which le Maire speaks of in the following terms: 'The havock which 'these monkeys make in the fields of Senegal when the 'millet and other grains are ripe, is not to be expressed. 'They assemble to the number of forty or fifty. One of 'them stands sentinel on a tree, listens, and looks about 'on all sides, while the others are busy. When he per'ceives any person, he sets up loud shrieks to alarm the 'band, who obey the signal, fly off with their prey, leaping 'from tree to tree with prodigious agility. The females, 'who carry their young in their arms, fly with the rest, 'and leap as if they were loaded with no burden.'

Though in every region of Africa the species of apes, baboons, and monkeys are very numerous, some of which are pretty similar; yet it is remarked by travellers that they never intermix, and that each species commonly inhabits a different quarter of the country.

Distinctive Characters of this Species.

The patas has cheek-pouches and callosities on his buttocks. His tail is as long as both his body and head. The top of his head is flat. His muzzle, body, and legs, are long. He has black hair on his nose, and a narrow band of the same colour above his eyes, which extends from ear to ear. The hair on the upper parts of his body is almost red, and that on the under parts, as the throat, breast, and belly, is of a yellow gray colour.

Plate 40.


Chinese bonnet.
Oistiti or Striated Monkey.
Malbrouck
Mico or Fair Monkey
Marikini or Silky Monkey.
Pinche or Red Monkey.
White Collar'd Mangabey.
Mangabey.

London Pub. by Richd. Evans White's Row Spital Flds 1816

This species varies in the colour of the band above the eyes. It is black in some, and white in others. They walk oftener on four than on two feet. When enraged they agitate not their jaws, like the other monkeys. From the point of the muzzle to the origin of the tail they are about a foot and a half or two feet in length. Some of them, as appears from the relations of travellers, are larger. The females menstruate.

THE MALBROUCK, AND CHINESE BONNET.

CHINESE monkey with a long smooth nose, of a whitish colour; hair on the crown of the head long, lying flat, and parted like that of a man; colour a pale cinereous brown.

These two monkeys seem to be of the same species, which, though different in some respects from that of the macaque, makes so near an approach to it, that we are doubtful whether the macaque, the egret, the malbrouck, and the Chinese bonnet, are four varieties only, or permanent races, of the same species. As these animals produce not in our climate, we cannot ascertain the identity or diversity of their species, but must judge from the differences in their figure and external qualities. The macaque and egret are so similar, that we presumed them to be one species. It is the same with the malbrouck and Chinese bonnet. But as the latter differ from the former more than they differ between themselves, we thought it best to separate them.

Our presumption, with regard to the diversity of these two species, is founded, 1. On the difference in their figure; 2. On those of the colour and disposition of the hair; 3. On the different proportions in the skeletons of the two kinds; and, in fine, on the two former being natives of the southern regions of Africa, while the two latter are natives of Bengal. This last consideration is of equal weight with any of the others; for we have shown, that in wild animals totally independent of man, the distance of climate is a pretty certain indication of remoteness of species. Besides, the malbrouck and Chinese bonnet are not the only species or races of monkeys found in Bengal. It appears, from the evidence of travellers, that there are four varieties, namely, white, black, red, and gray monkeys. They alledge that the black kind are most easily tamed. Those we saw were of a reddish gray colour, and appeared to be tame and even docile.

[The monkey of Calicut, with grayish hair, mentioned by Pyrard, should probably be referred to the malbrouck species. In this country, the killing of monkeys is prohibited. They are so importunate, troublesome, and numerous, that they do much damage. The inhabitants of the towns and villages are obliged to lattice their windows, to prevent the monkeys from entering their houses.—*Fr. Pyrard.*]

'These animals,' Innigo de Biervillas remarks, 'steal 'fruits, and particularly the sugar cane. One stands 'sentinel on a tree, while the others load themselves 'with the booty. If he perceives any person, he cries '*houp, houp, houp,* with a loud and distinct voice. The 'moment this signal is given, the whole troop throw 'down the canes they held in their left hand, and run 'off on three feet. When pursued hard they quit what 'they had in their right hand, and save themselves by 'climbing trees, which are the usual places of their 'abode. They leap from tree to tree; and even the 'females, though loaded with their young, which they 'hold firmly, leap like the others; but they sometimes 'fall. These animals are never more than half tamed, 'and always require a chain. Even in their own country 'they never produce when in bondage: they require to 'be at perfect freedom in the woods. When fruits and 'succulent plants fail, they eat insects, and sometimes 'descend to the margins of rivers, and the sea-coast, to 'catch fishes and crabs. They put their tail between 'the pincers of the crab, and whenever the pincers are 'closed, they carry it quickly off, and eat it at their 'leisure. They gather cocoa nuts, and are well acquainted with the method of extracting the juice for 'drink, and the kernel for food. They likewise drink 'the *zari* that drops from the *bamboos,* which they place 'on the tops of trees, in order to extract the liquors; 'and they use it occasionally. They are taken by means 'of a cocoa nut, with a small hole made in it. They 'put their paw into the hole with difficulty, because it 'is narrow; and the people who are watching seize 'them before they can disengage themselves. In the 'provinces of India inhabited by the Bramins, who kill 'no animals, the number of monkeys, which are highly 'venerated, is almost infinite. They come in troops into 'the cities, and enter the houses at all times with perfect freedom; so that those who sell provisions, and 'particularly fruits, pot-herbs, &c. have much difficulty 'in preserving their commodities.' In Amadabad, the capital of Guzarat, there are three hospitals for animals, where lame and sick monkeys, and even those who without being diseased choose to dwell there, are fed and cherished. Twice every week the monkeys in the neighbourhood assemble spontaneously in the streets of the city. They then mount upon the houses, each of which has a small terrace or a flat roof, where they lie during the great heats. On these two days the inhabitants fail not to lay upon these terraces rice, millet, sugar canes, and other fruits in their season; for if these animals by any accident find not their provisions in the accustomed place, they break the tiles which cover the rest of the house, and commit great outrages. They never eat any thing without thoroughly examining it; and when full, they fill their cheek-pouches for another occasion. In places frequented by the monkeys the birds dare not build their nests on the trees; for they never fail to destroy the nests, and dash the eggs on the ground.

Neither the tiger nor other ferocious animals are the most formidable enemies to the monkeys; for they easily make their escape by their nimbleness, and by living on the tops of trees, where nothing but serpents have the art of surprising them. 'The apes,' a traveller remarks, 'are masters of the forests; for their dominion 'is not disputed either by the tiger or lion. The only 'animals they have to dread are the serpents, who make 'perpetual war upon them. Some of these serpents are 'of a prodigious size, and swallow an ape in a moment. 'Others are smaller, but more agile, and go in quest of 'the apes on the trees. They watch the time when the 'apes sleep,' &c.

Distinctive Characters of these Species.

The malbrouck has cheek-pouches and callosities on his buttocks. The tail is nearly as long as both the body and head. The eye-lids are flesh-coloured, and the face of a cinereous gray. The eyes and muzzle are large. The ears are large, thin, and flesh-coloured. He has a band of gray hair, like the mone or varied monkey; but the superior parts of his body are of a uniform yellowish brown colour, and the inferior are of a yellowish gray. He walks on four feet, and is about a foot and a half long from the point of the muzzle to the origin of the tail.

The Chinese-bonnet appears to be a variety of the malbrouck. They differ in the two following articles: in the former the hair on the top of the head is disposed in the form of a flat bonnet, from which its name has been derived, and its tail is proportionally longer. The females of both these races are subject to a periodic evacuation.

THE MANGABEY, OR MONKEY WITH WHITE EYE-LIDS

MONKEY with a long, black, naked, and dog-like face; the upper eye-lids of a pure white; ears black, and like the human; no canine teeth; hairs on the sides of the face, beneath the cheeks, longer than the rest; tail long; colour of the whole body tawny and black; flat nails on the thumbs and fore-fingers; blunt claws on the others; hands and feet black.

We have had two individuals of this species, both of which were sent to us under the appellation of *Madagascar apes*. It is easy to distinguish the mangabeys from all the other monkeys by a very remarkable character. Their eye-lids are naked, and of a very splendid white colour. They have a thick, broad, long muzzle, and a prominent ring round their eyes. Some of them have the hair on the head, neck, and upper part of the body of a yellow brown colour, and that on the belly white. In others the hair on the head and body is lighter; and they are distinguished from the rest by a broad collar of white hair which surrounds their neck and cheeks. Both carry their tail arched, and its hair is long and bushy. They come from the same country as the vari or ruffed maucauco; and as they resemble him in the length of the muzzle and tail, in the manner of carrying the latter, and in the varieties of colour, they seem to form the shade between the *makis* and the guenons, or long-tailed monkeys.

Distinctive Characters of this Species.

The mangabey has cheek-pouches and callosities on the buttocks. The tail is as long as both the body and head. He has a prominent ring round the eyes, and the upper eye-lid is extremely white. The muzzle is thick and long. The eye-brows consist of stiff crisped hair, and the ears are black and almost naked. The hair on the superior parts of the body is brown, and that on the inferior is gray. There are varieties in this species: some of them are of a uniform colour; others have a white circle round the neck, and round the cheeks, in the form a beard. They walk on four feet, and are nearly a foot and a half long from the extremity of the muzzle to the origin of the tail. The females of these species menstruate.

THE MONA, OR VARIED MONKEY.

VARIED monkey, with a short thick nose, of a dirty flesh colour; hair on the sides of the face, and under the throat, long; the colour yellow and black; on the forehead, gray; above the eyes, from ear to ear, a black line; the upper part of the body dusky and red; the belly whitish; outside of the thighs, and the feet, black; the tail of a cinereous brown; length about a foot and a half, the tail above two.

The mona is the most common of the monkeys. We had one alive for several years. The mona and the magot agree best with the temperature of our climate. This circumstance is alone sufficient to prove, that the mona is not a native of the southern regions of Africa and the East Indies; and, in fact, it is found in Barbary, Arabia, Persia, and other parts of Asia which were known to the ancients, who called it *kebos, cebus,* or *cœphus,* on account of the variety of its colours. Its face is brown, with a kind of beard interspersed with white, yellow, and a little black. The hair on the top of the head and neck is a mixture of yellow and black: that on the back is a mixture of red and black. The belly, as well as the inside of the thighs and legs, are whitish. The external parts of the legs and feet are black, and the tail is of a deep gray colour. There are two small white spots, one on each side of the root of the tail, a crescent of gray hair on the front, and a black band from the eyes to the ears, and from the ears to the shoulders and arms. Some have called it *nonne* from a corruption of *mone* or *mona,* and others the *old man,* on account of its gray beard. But the vulgar appellation of *varied monkey* is best known, and corresponds with the Greek name *kebos,* and Aristotle's definition of the *monkey with a long tail, and various colours.*

In general, the monkeys have milder dispositions than the baboons, and their character is less melancholy than that of the apes. They are extravagantly vivacious; but have no ferocity; for they become tractable the moment their attention is fixed by fear or restraint. The is particularly susceptible of education, and even some attachment to those who take care of him. Th one we kept allowed himself to be touched and carried about by the people with whom he was acquainted; but, to others, he permitted not this freedom, and even bit them. He likewise endeavoured to obtain his liberty: he was fixed with a long chain. When he could either break the chain or disengage himself, he fled to the fields, and, though he did not spontaneously return, he allowed himself to be taken by his master. He eat every thing, roasted meat, bread, and particularly fruits. He likewise searched for spiders, ants, and insects. When several morsels were thrown to him at once, he filled his cheeks with them. This practice is common to all the baboons and monkeys, to whom Nature has given pouches in their cheeks, where they can keep a quantity of food sufficient to nourish them for a day or two.

Distinctive Characters of this Species.

The mona has cheek-pouches, and callosities on the buttocks. The tail is about two feet long, and more than half a foot longer than both the body and head. The head is small and round; the muzzle is thick and short; and the face is of a bright tawny colour. He has a gray band upon the front, and a black band extending from the eyes to the ears, and from the ears to the shoulders and arms. He has a kind of gray beard, formed by the hairs on his throat, which is longer than the others. The hair on the body is a reddish black, and that on the belly is whitish. The outside of the legs and feet are black; and the tail is of a grayish brown colour, with two white spots on each side of its root. He walks on four feet; and his length, from the point of the muzzle to the origin of the tail, is about a foot and a half. The female is subject to the *menses.*

THE CALLITRIX, OR GREEN MONKEY.

GREEN monkey, with a black and flattish face, the sides of it bounded by long white hairs, falling backwards, and almost covering the ears, which are black, and like the human; head, limbs, and whole upper part of the body and tail, covered with soft hairs, of a yellowish green colour at their ends, and cinereous at their roots; under side of the body and tail, and inner side of the limbs, of a silvery colour, tail very long and slender; size of a small cat.

Callitrix is a term employed by Homer, to denote, in general, the beautiful colour of the hair of animals. It was not till several ages after Homer's time, that the

Greeks applied this name to particular species of monkeys. Its application to the animal under consideration is peculiarly proper. The body is of a beautiful green colour, the throat and belly are white, and the face is of a fine black. He is found in Mauritania, and in the territories of ancient Carthage. Hence it is probable that he was known to the Greeks and Romans, and that it was one of those long-tailed monkeys to which they give the name of *callitrix*. In the neighbourhood of Egypt, both on the Ethiopian and Arabian side, there are white monkeys, which the ancients have likewise denoted by the generic name of *callitrix*. Prosper Alpinus and Pietro della Valle mention these white monkeys. We have not seen this species: it is perhaps only a variety of the green monkey, or of the *mona*, which is very common in these countries.

The green monkey seems also to be found in Senegal, as well as in Mauritania and the Cape de Verd islands. M. Adanson relates, that the woods of Podor, along the river Niger, are filled with green apes. 'I discovered 'apes,' says he, 'only by the branches they throw 'down from the tops of the trees; for, in other respects, 'they are so silent and nimble in their gambols, that it 'would be difficult to perceive them. I killed one, two, 'and even three, before the others seemed to be alarmed. 'However, after most of them were wounded, they be'gan to take shelter; some of them concealed them'selves behind the large branches, some descended on 'the ground, and the greatest number sprung from the 'top of one tree to another. During this operation, I 'continued to shoot, and, in the space of twenty fa'thoms, I killed twenty-three in less than an hour, and 'not one of them uttered the smallest cry, though they 'frequently assembled in troops, grinded their teeth, 'and assumed a threatening aspect, as if they meant to 'attack me.'—*M. Adanson.*

Distinctive Characters of this Species.

The callitrix has cheek-pouches and callosities on the buttocks. The tail is much longer than both the body and head. The head is small, the muzzle long, and the face and ears are black. Instead of eye-brows, a band of black hairs runs along the bottom of the front. The body is of a vivid green mixed with a little yellow. He walks on four feet; and the length of his body, comprehending that of the head, is about fifteen inches. The female is subject to the menstrual flux.

THE MUSTACHE.

MUSTACHE monkey, with a short nose, the end marked with a transverse line of pure white; the face naked, and of a dusky blue; on the cheeks, before the eyes, two large tufts of yellow hairs, like mustaches; the hair on the top of the head long and upright; round the mouth are some black hairs; the colour of the hair on the head yellow, on the body and limbs, a mixture of red and ash-colour; the rest yellowish; the under part of the body paler than the upper; the feet black; the nails flat: its length one foot, that of the tail eighteen inches.

The mustache seems to belong to the same country as the macaque; because, like the latter, his body is shorter and more squat than in the other monkeys. It is probably the same animal which the voyagers to Guinea have called *white-nose;* because the lips below the nose are of a bright white colour, and the rest of the face is of a blackish blue. There are also two tufts of yellow hair under the ears, which give it a singular appearance; and, as it is, at the same time, very small, it appears to be the most beautiful of all the monkeys.

Distinctive Characters of this Species.

The mustache has cheek-pouches and callosities on the thighs. Its tail is much longer than the body and head, being nineteen or twenty inches in length. Its face is of a bluish black colour, with a large white mark which extends over the whole upper lip, which is naked, except a border of black hairs that surrounds the margins of both lips. Its body is short and squat. It has two tufts of bright yellow hair under the ears, and likewise a tuft of curled hair on the top of the head. The hair on the body is of a greenish ash-colour, and that on the breast and belly is of a whitish ash-colour. It walks on four feet; and, from nose to tail, exceeds not eighteen inches in length. The female is subject to the menstrual flux.

THE TALAPOIN.

THE talapoin monkey, with a sharp nose, round head, large black naked ears; eyes and end of the nose flesh-coloured; hair on the cheeks very long, and reflected towards the ears: on the chin a small beard; the colour of the whole upper part of the body and the outside of the limbs a mixture of dusky yellow and green; the lower part white tinged with yellow; the tail very long and slender; above, of an olive colour; beneath, cinereous; the paws black. Its length is about one foot, and that of the tail one foot five inches.

Though the size of this monkey be small, its figure is beautiful. Its name seems to indicate that it comes from Siam and the other eastern provinces of Asia. It is certain, however, that it is a native of the Old Continent, and exists not in the New; because it has cheek-pouches and callosities on the buttocks, neither of which characters belong to the sagoins or sapajous, the only American animals who can be compared to the monkeys. But independent of the name, I am inclined to think that this monkey is more common in the East Indies than in Africa; because it is affirmed by voyagers, that most of the apes in this part of Asia are of a brownish green colour. 'The apes of Guzarat are of a brownish 'green colour, and have long white beards, and eye-'brows. These animals, which the Banians from a reli-'gious principle, allow to multiply without end, are so 'familiar, that numbers of them perpetually enter the 'houses; and the sellers of fruits and confections have 'much difficulty in preserving their wares.'

Mr. Edwards has given a figure and description of a monkey, under the denomination of *the middle-sized black ape*, which seems to make a nearer approach to the talapoin than any other. I here add Edwards's description.

[This monkey was about the size of a large cat, of a gentle nature in respect to any one. He loved playing with a kitten, as most monkeys do. He was a little vicious, according to their nature, being a male.

His head was pretty round; the skin of the face of a tawny flesh-colour, thinly covered with black hair; the ears were shaped like the human. The eyes were of a reddish hazel colour, with black pupils. The hair was long above the eyes, and the eye-brows joined together; it was also long on the temples, which partly covered the ears. The head, back, arms, legs, and tail, were covered with pretty long, loose, dusky, black hair, not very harsh or over soft. His breast, belly, &c. were almost bare of hair, of a dusky flesh colour, with two nipples on the breast. The four paws were all of them formed something like a human hand; they are covered with black soft skin, having little or no hair on them; the nails are flat.—*Edwards's Gleanings.*]

If the size and colour be excepted, they have such a resemblance to each other, that they may be regarded as species very nearly allied, if not varieties of the same. In this case, as we are not certain that our talapoin is a native of the East Indies, and as Edwards assures us that his monkey came from Guinea, we must refer the talapoin to the same climate, or rather suppose that it is common to the southern regions of both Africa and Asia. It is probably the same species of black apes mentioned by Bosman, under the name of *bourdmannetjes*, whose skin, he remarks, is an excellent fur.

[In Guinea there is a third species of ape, which is very beautiful, and generally exceeds not two feet in length. Its hair is extremely black, and more than an inch long, and its beard is white; from which circumstance the Dutch call it *bourdmannetje*. Bonnets are made of their skins, and each fur sells at four crowns.—*Bosman.*]

THE DOUC, OR COCHIN-CHINA MONKEY.

DOUC is the name of this animal in Cochin-China. It is called *sifac* in Madagascar.

Cochin-China monkey, with a short flattish face, bounded on each side by long hairs of a yellowish white colour; on the neck a collar of purplish brown; the lower part of the arms, thighs, and tail, are white; the upper part of the arms and thighs black; the back, belly, and sides, gray, tinged with yellow: above the root of the tail is a spot of white, which extends beneath, as far as the lower part of the belly and part of the thighs: the feet are black, and the buttocks covered with hair. This is a very large species, about four feet long from the nose to the tail; but the tail not so long.

The douc is the last of that *class* of animals which we have called *apes, baboons,* and *monkeys*. Without being precisely any of these three kinds, he participates of each. He is allied to the monkeys by the length of his tail, to the baboons by his size, and to the apes by his flat face. He seems, by a particular character, to form the shade between the monkeys and sapajous: in these two tribes of animals the monkeys are distinguished by naked buttocks, and all the sapajous have these parts covered with hair: of all the monkeys, the douc alone has hair on the buttocks, like the sapajous. He resembles them also in the flatness of the muzzle. But upon the whole he has much more affinity to the monkeys than to the sapajous, from which he differs by his tail not being prehensile, and by other essential characters. Besides, the interval which separates the two tribes is immense; for the douc and all the monkeys belong to the Old Continent, and all the sapajous are natives of the New World. It may likewise be remarked, that as the douc, like the monkeys, has a long tail, but has no callosities on the buttocks, he forms the shade between the orang-outangs and monkeys; as the gibbon does on another account, having no tail, like the orang-outangs, but, like the monkeys, having callosities on the buttocks. Independent of these general relations the douc has peculiar characters, which render him distinguishable at first sight from the apes, baboons, monkeys, and sapajous. His robe, which is variegated with many colours, seems to indicate the ambiguity of his nature, and distinguishes his species in a conspicuous manner. Round his neck there is a collar of a purplish blue colour. A white beard surrounds his cheeks. His lips are black, and he has a black ring round his eyes. His face and ears are red, the top of his head and body gray, the breast and belly yellow. His legs are white below and black above. His tail is white, with a large spot of the same colour on his loins. The feet are black, with several shades of different colours.

This animal, which I was assured came from Cochin-China, is likewise found in Madagascar; and it is the same with what Flacourt mentions under the name of *sifac* in the following terms: ‘In Madagascar there is ‘another species of white monkey, with a tawny collar, ‘which frequently walks on the two hind legs. It has ‘a white tail, and two tawny spots on the flanks. It is ‘larger than the *vari* (maucauco), and smaller than the ‘*varicossi* (vari). This species is called *sifac,* and feeds ‘upon beans. It is very frequent about Andrivoura, ‘Dambourlomb, and Ranafoulchy.’ The tawny collar, the white tail, and the spots on the flanks, indicate, in the clearest manner, that the sifac of Madagascar is the same species with the douc of Cochin-China.

Travellers assure us, that in the stomachs of the large apes in the southern provinces of Asia bezoars are found of a superior quality to those of the goats and gazelles. These large apes are the ouanderou and the douc; and of course to them the production of the bezoars must be referred. It is alledged, that the bezoars of the ape are always round, while the other kinds are of different figures.

[As the apes, as well as the goats, eat the buds of certain shrubs, bezoar stones are produced in their bellies. They are often found in the excrements which they discharge when flying from danger. These stones are dearer and more esteemed than any other kind: they are likewise round, and have more powerful virtues. One grain of this bezoar has been found to have an equal effect with two of that produced by the goats.—*Descript. Hist. de Macacar.*] *Nota*—From comparing this passage with that of Knox, related in the article *ouanderou*, it appears, that the ouanderous feed upon the buds of trees, and of course most commonly produce bezoars.

Distinctive Characters of this Species.

The douc has no callosities on the buttocks, but is every where covered with hair. His tail is not so long as his body and head. His face is covered with a reddish down. The ears are naked, and of the same colour with the face. The lips, as well as the orbits of the eyes, are brown. The colours of the hair are vivid and various. He has a purplish brown collar round his neck. He has white on his front, head, body, arms, legs, &c. and a kind of yellowish white beard. The top of the front, and the upper part of the arms, are black. The under parts of the body are of a cinereous gray, and a whitish yellow colour. The tail and under part of the loins are white. He walks as often on two as on four feet. When erect he is three and a half or four feet high. It is uncertain whether the females of this species be subject to the menstrual discharge.

THE SAPAJOUS, AND THE SAGOINS.

We now pass from the Old Continent to the New. All the four-handed animals formerly described, and which were comprehended under the generic names of *apes, baboons,* and *monkeys,* belong exclusively to the Old Continent; and all the rest, whose history we are about to relate, are found in the New World only. We first distinguish them by the two generic names *sapajous* and *sagoins*. The feet of both are constructed nearly in the same manner with those of the apes, baboons, and monkeys. But they differ from the apes by having tails. They differ from the baboons by the want of cheek-pouches and callosities on their buttocks. In fine, they differ from the apes, baboons, and monkeys, by having the portion between their nostrils very broad and thick, and the apertures placed to a side and not under the nose. Hence the sapajous and sagoins differ not only specifically but generically from the apes, baboons, and monkeys. When compared with each other we likewise find that they differ in generic characters; for all the sapajous have prehensile tails, which are so constructed that the animals can use them as fingers to lay hold of objects. This under part of the tail, which they fold, extend, curl up, or unfold at pleasure, and by the extremity of which they suspend themselves on the branches of trees, is generally deprived of hair, and covered with a smooth skin. The tails of all the sagoins, on the contrary, are proportionally longer than those of the sapajous, and are straight, flaccid, and entirely covered with hair; so that they can neither use the tail in laying hold of objects, nor in suspending themselves. This difference alone is sufficient to distinguish a sapajou from a sagoin.

We know eight sapajous, which may be reduced to five species: 1. The *ouarine* or *gouariba* of Brasil. This sapajou is as large as a fox, and differs from the *alouate* of Cayenne in colour only. The hair of the ouarine is black, and that of the alouate is reddish; and as they resemble each other in every other respect I consider them as belonging to the same species. 2. The *coaita*, which is black like the ouarine, but not so large. The *exquima* seems to be a variety of this species. 3. The *sajou*, or *sapajou* properly so called, is small, of a brown colour, and commonly known by the name of the capuchin monkey. Of this species there is a variety, which we shall call the *gray sajou*, to distinguish it from the *brown sajou*. 4. The *sai*, which some travellers have called the *weeper*, is somewhat larger than the sajou, and has a broader muzzle. There are two kinds which differ in colour only, the one being reddish brown and the other whitish red. 5. The *saimiri*, which is commonly called the *orange monkey*. It is the smallest and most beautiful of the sapajous.

We are acquainted with six species of sagoins: 1. The *saki*, which is the largest, and whose tail is covered with hair so long and bushy that it has been called the *fox-tailed monkey*. There seems to be a variety in this species. I have seen two, both of which appeared to be adults; but the one was almost twice as large as the other. 2. The *tamarin* is generally black, with the four feet yellow. But they vary in colour; for I have seen some of them brown, and spotted with yellow. 3. The *ouistiti*, which is remarkable for large tufts of hair round its face, and an annulated tail. 4. The *marikina*, which has a mane round the neck, and bushy hair, like the lion, at the end of the tail. From this circumstance it has received the appellation of the *lion monkey*. 5. The *pinche*, whose face is of a beautiful black colour, with hair which descends from the top and each side of the head in the form of long smooth tresses. 6. The *mico* is the most beautiful of the sagoins. Its hair is of a silver white colour, and its face is as red as vermilion.

We proceed to the history and description of each of these sapajous and sagoins, most of which have hitherto been unknown.

THE OUARINE, AND ALOUATE.

OUARINE is the name of this animal at Maragnon. The preacher monkey, with black shining eyes, short round ears, and a round beard under the chin and throat. The hairs on the body are of a shining black, long, yet lie so close on each other that the animal appears quite smooth. The feet and end of the tail are brown. The tail is very long, and always twisted at the end. It is of the size of a fox.

The ouarine and alouate are the largest four-handed animals in the New Continent. In size they much exceed the largest monkeys, and approach to the magnitude of baboons. They have prehensile tails, and consequently belong to the family of sapajous, in which they hold a distinguished rank, not only by their stature, but also by their voice, which resounds like a drum, and is heard at a great distance. Marcgrave relates, ‘That every ‘morning and evening the ouarines assemble in the ‘woods; that one of them takes a more elevated station, ‘and gives a signal with his hand for the others to sit ‘around and listen to him; that when he perceives them ‘to be all seated, he begins a discourse, in a tone so loud ‘and rapid as to be heard at a great distance; and a ‘person would be led to think that the whole were crying together; that all the rest, however, keep the most ‘profound silence; that when he stops, he gives a signal ‘with his hand for the others to reply; that in an instant 'the whole cry together; till he commands silence by 'another signal, which they obey in a moment; that the 'first resumes his discourse or song; and that after 'hearing him attentively for a considerable time the 'assembly breaks up.' These facts, which Marcgrave says he has often witnessed, may perhaps be exaggerated, and seasoned a little with the marvellous: the whole may be founded on the terrible noise made by these animals. They have a kind of osseous drum in their throat, in the concavity of which the sound is augmented, multiplied, and makes a howling noise. Hence these sapajous have been distinguished from all others by the name of *howlers*. We have never seen the ouarine, but have the skin of an alouate, and likewise a dried fœtus of the same species, in which the bone of the throat, the instrument of the great noise he makes, is already perceptible. According to Marcgrave the ouarine has a large square face, black and brilliant eyes, short roundish ears, and a tail naked at the extremity, which adheres firmly to every thing it can embrace. The hair on the whole body is black, long, smooth, and lustrous; that on the chin and throat is longer, and forms a kind of round beard; and that on the hands, feet, and part of the tail, is brown. The female is of the same colour with the male, and differs from him only by being smaller. The females carry their young on their back, and leap with them from branch to branch, and from tree to tree. The young embrace with their arms and hands the narrowest part of the mother's body, and remain firmly fixed as long as she is in motion. Besides, these animals are so wild and mischievous that they can neither be conquered nor tamed. They bite cruelly; and though not carnivorous they fail not to excite terror by their frightful voice and their ferocious aspect. As they feed only upon fruits, pot-herbs, grain, and some insects, their flesh is not bad eating 'The hunters,' Oexmelin remarks, 'bring home in the 'evening the monkeys they kill in the country of Cape 'Gracias-a-Dio. They roast one part of these mon- 'keys, and boil the other: the flesh is good, and resem- 'bles that of the hare; but it is sweetish, and requires 'a great deal of salt in dressing. The fat is very good, 'and as yellow as that of a capon. We lived upon these 'animals during all the time we remained there, because 'we could procure no other food, and the hunters sup- 'plied us daily with as many as we could eat. I went 'to see this species of hunting, and was surprised at the 'sagacity of these animals, not only in distinguishing 'particularly those who make war against them, but 'when attacked in defending themselves, and providing 'for their own safety. When we approached they all 'assembled together, uttered loud and frightful cries, 'and threw at us dried branches which they broke off 'from the trees. Some of them voided their excrements 'in their hands, and threw them at our heads. I like- 'wise remarked that they never abandoned one another; 'that they leapt from tree to tree with incredible agility; 'and that they flung themselves headlong from branch 'to branch, without ever falling to the ground; be- 'cause before reaching the earth they always caught 'hold of a branch either with their hands or tail; so 'that if not shot dead at once they could not be laid 'hold of; for even when mortally wounded they remain 'fixed to the trees, where they often die, and fall not 'till they are corrupted. More than four days after death 'I have seen them firmly fixed to the trees; and fifteen 'or sixteen of them are frequently shot before three or 'four of them can be obtained. What is singular, as 'soon as one is wounded, the rest collect about him, 'and put their fingers into the wound, as if they meant 'to sound it; and when much blood is discharged some 'of them keep the wound shut, while others make a 'mash of leaves. and dexterously stop up the aperture. 'This operation I have often observed with much admi- 'ration. The females bring forth but one young, which 'they carry in the same manner as the Negresses do 'their children. The young monkey embraces its mother's 'neck with the two fore feet, and with the two hind it 'lays hold of the middle of her back. When she wants 'to give it suck, she takes it in her paws, and presents 'the breast to it, like a woman. There is no other me- 'thod of obtaining the young but by killing the mother; 'for she never abandons it. When she is killed, it falls 'from her, and may then be seized. When these ani- 'mals are embarrassed, they assist each other in passing 'a brook, or from one tree to another. Their cries are 'heard at the distance of more than a league.'

Most of these facts are confirmed by Dampier. He assures us, however, that the females generally produce two young, one of which the mother carries between her arms, and the other on her back. In general, the sapajous, even, of the smallest species, are not very prolific; and it is probable that the largest produce not above one or two at a time.

['The monkeys found in the neighbourhood of the Bay of Campeachy are the ugliest I ever saw. They are much bigger than a hare, and have great tails, about two feet and a half long. The under side of their tails is all bare, with a black hard skin; but the upper side, and all the body, is covered with coarse, long, black, staring hair. These creatures keep together 20 or 30 in a company, and ramble over the woods, leaping from tree to tree. If they meet with a single person they will threaten to devour him. When I have been alone, I have been afraid to shoot them, especially the first time I met them. They were a great company dancing from tree to tree over my head, chattering and making a terrible noise, and a great many grim faces, and shewing antick gestures. Some broke down dry sticks and threw at me; others scattered their urine and dung about my ears; at last one bigger than the rest came to a small limb just over my head, and leaping directly at me, made me start back; but the monkey caught hold of the bough with the tip of his tail, and there continued swinging to and fro, and making mouths at me. At last I past on, they still keeping me company, with the like menacing postures, till I came to our huts. The tails of these monkeys are as good to them as one of their hands; and they will hold as fast by them. If two or more of us were together, they would hasten from us. The females with their young ones are much troubled to leap after the males; for they have commonly two: one she carries under one of her arms; the other sits on her back, and clasps her two fore paws about its neck. These monkeys are the most sullen I ever met with, for all the art we could use would never tame them. It is a hard matter to shoot one of them so as to take it, for if it gets hold with its claws or its tail, it will not fall so long as one breath of life remains. After I have shot at one, and broke a leg or an arm, I have pitied the poor creature to see it look and handle the wounded limb, and turn it about from side to side. These monkeys are very rarely, or (as some say) never on the ground.'—*Dampier.*]

Distinctive Characters of this Species.

The ouarine has the apertures of the nostrils placed at a side, and not under the nose; the partition of the nostrils is very thick. He has neither cheek-pouches, nor callosities on the buttocks, which are covered with hair, like the rest of the body. He has a long prehensile tail, black, long hair, and a large concave bone in his throat. He is of the size of a greyhound; and the long hair under his neck forms a kind of round beard. He generally walks on four feet.

The alouate has the same characters with the ouarine, and only differs from him by having a larger beard, and the hair of a reddish brown colour. I know not whether the females of these species be subject to the menses: from analogy I should presume that they are not, having generally found, that the apes, baboons, and monkeys with naked buttocks, are alone subject to this evacuation.

THE COAITA, AND EXQUIMA.

FOUR-FINGERED monkey with a long flat face, of a swarthy flesh colour; eyes sunk in the head; ears like the human; limbs of great length, and uncommonly slender; hair black, long, and rough; only four fingers on the hand, being quite destitute of a thumb; five toes on the feet; nails flat; tail long, and naked below, near the end; body slender; about a foot and a half long; tail near two feet, and so prehensile as to serve every purpose of a hand.

Next to the ouarine and alouate, the coaita is the largest of the sapajous. I saw one of them at the palace of the Duke of Bouillon, where by its familiarity, and even its caresses, it procured the affection of those to whose charge it was committed. But notwithstanding all the care and attention it received, it was unable to resist the cold of the winter 1764. It died, to the regret of its master, who was so obliging as to send it to me, to be placed in the Royal Cabinet. I saw another in the house of the Marquis de Montmirail. This was a male, and the former a female. Both were equally tractable and well tamed. Hence this sapajou, by its mild and docile disposition, differs much from the ouarine and alouate, who are so wild that no art can tame them. Neither has it, like them, an osseous pouch in the throat. Like the ouarine its hair is black but rough. The coaita likewise differs from all the other sapajous by having only four fingers on his hands. By this character and his prehensile tail, he is easily distinguished from the monkeys who have all five fingers and a flaccid tail.

The animal called *exquima* by Marcgrave is very nearly allied to the *coaita,* and is perhaps only a variety of that species. This author seems to have been deceived when he tells us, that the exquima is a native of Guinea and Congo. The figure he has given of it was alone sufficient to have convinced him of his error; for it represents this animal with a tail rolled up at the point, a character which belongs exclusively to the sapajous. Of course Marcgrave's exquima is not a monkey of Guinea, but a sapajou with a prehensile tail, which had been transported thither from Brasil. The name *exquima,* or *quima,* by extracting the article *ex,* and which ought to be pronounced *quoima,* is not very different from *quoaita,* the manner in which several authors spell *coaita.* Hence every circumstance concurs in establishing Marcgrave's *exquima,* which he calls a Guinea monkey, to be a Brasilian *sapajou,* and a variety only of the coaita, which it resembles in disposition, size, colour, and the prehensile tail. The most remarkable difference is, that the exquima has whitish hair on the belly, and a white beard, two inches long, under the chin: our coaitas have neither a beard nor white hair on the belly. But these differences seem not sufficient to constitute two distinct species; for we learn from the evidence of travellers, that some coaitas are black and others white, and some have beards and others no beards. 'There are,' says Dampier, 'great droves of monkeys, some of them 'white, but most of them black; some have beards, 'others are beardless. They are of a middle size, yet 'extraordinary fat at the dry season, when the fruits are 'ripe; and they are very good meat, for we ate of them 'very plentifully. The Indians were shy of eating them 'for a while; but they were soon persuaded to it by seeing us feed on them so heartily. In the rainy season 'they have worms in their bowels. I have taken a handful of them out of one monkey we cut open; and some of 'them seven or eight feet long. They are a very waggish 'kind of monkey, and played a thousand antick tricks 'as we marched at any time through the woods, skipping from bough to bough, with the young ones hanging at the old ones' backs, making faces at us. To pass 'from top to top of high trees, whose branches are a little 'too far asunder for their leaping, they will sometimes 'hang down by one another's tails in a chain; and 'swinging in that manner, the lowermost catches hold 'of a bough of the other tree, and draws up the rest of 'them.' All these facts, even the worms in the intestines, correspond with our coaitas. M. Daubenton, in dissecting these animals, found a great number of worms, some of which were from twelve to thirteen inches long. It is obvious, therefore, that the exquima of Marcgrave is a sapajou of the same species, or at least of a species very nearly allied to that of the coiata.

We must likewise remark, that if the animal mentioned by Linnæus, under the name of *diana*, is really, as he says, the *exquima* of Marcgrave, he has omitted the *prehensile tail*, which is the most essential character, and ought alone to determine whether this *diana* belongs to the genus of *sapajous* or to that of the *monkeys*, and of course whether it is found in the Old or the New Continent.

Independent of this variety the characters of which are conspicuous, there are other varieties, though less remarkable, in the species of the coaita. That described by M. Brisson had whitish hair on all the under parts of the body. But those I have seen were entirely black, and had very few hairs on the inferior parts of the body, where the skin appeared, and was equally black with the hair. Of the two coaitas mentioned by Mr. Edwards, the one was black and the other brown. On account of the length and slenderness of their legs and tail they were called *spider monkeys*.

Some years ago a coaita was sent me, under the denomination of *chamek*, which I was told came from the coast of Peru. [This animal was brought from the coast of Bancet in Peru, when thirteen months old. It weighed about six pounds. The whole body was black. The skin of the face was naked, of a coarse grain, and of the colour of a Mulatto. The hair was coarse, and from two to three inches in length. The ears, which resembled those of man, were naked, and of the same colour with the face. The tail was one foot ten inches long, five inches thick at the base, and about one inch at the point. It was round, and garnished with hair above and below about thirteen inches from the origin, but naked below nine inches from the extremity, where the under part of it is flat and furrowed in the middle, and round above. This animal suspends itself by the tail, and likewise uses it as a fifth hand to lay hold of any thing it wants. Its length was thirteen inches from the point of the nose to the origin of the tail. It had only two paps, placed nearly under the arm-pits.] From this description it will appear that this chamek of Peru, with the exception of a few varieties, is the same with the coaita of Guiana.

These sapajous are very dexterous and intelligent. They go in companies, and mutually warn and assist each other. It uses its tail as a fifth hand, and seems to employ this instrument more than either its hands or feet. To balance this advantage, Nature has deprived this animal of a thumb. We are assured that it seizes fishes with its tail; which is by no means incredible; for we have seen one of our coaitas lay hold in this manner of a squirrel, which had been put into its chamber as a companion. They have the address to break the shells of oysters in order to eat them. It is certain, that with a view to pass from one tree to another, whose branches are too distant for a leap, they form a chain by hanging down linked to each other by their tails, and swinging in that manner till the lowest catches hold of a branch, and draws up the rest. They sometimes pass rivers by the same expedient. The females bring forth but one or two young, which they always carry on their back. They eat fishes, worms, and insects; but fruits are their common food. When the fruits are ripe they become very fat, and their flesh is then said to be excellent.

Distinctive Characters of these Species.

The coaita has neither cheek-pouches nor callosities on the buttocks. He has a very long prehensile tail. The partition of the nostrils is very thick, and their apertures are placed at a side, and not under the nose. He has only four fingers on his hands or fore feet. Both his hair and skin are black. His face is naked and tawny. His ears are also naked, and resemble those of man. He is about a foot and a half in length; and his tail is longer than the body and head together. He walks on four feet.

The exquima is nearly of the same size with the coaita, and has likewise a prehensile tail. But his colour, instead of being black, is variegated. The hairs on his back are black and yellow, and white on the throat and belly. He has, besides, a remarkable beard. These differences, however, are not sufficient to constitute two distinct species; especially as some coaitas are not entirely black, but are whitish on the throat and belly. The females of these two species are not subject to the periodical evacuation.

THE SAJOU, OR CAPUCHIN MONKEY.

THE capuchin monkey, with a round head, and a short flesh-coloured face, with a little down on it; hair on the forehead more or less high and erect in different subjects; top of the head black and dusky, hair on it pretty long; hind part of the neck, and middle of the back, covered with long dusky hairs; rest of the back and the limbs of a reddish brown; hands and feet covered with a large skin; tail longer than the head and body, and often carried over the shoulders; the hair on it very long, of a deep brown colour, and appears very bushy from beginning to end: it is a species that varies a little in colours, which induced Linnæus to form three species of this one.—*Pennant.*

We are acquainted with two varieties of this species, the *brown sajou*, or capuchin monkey; and the *gray sajou*, which differs from the brown in colour only. They are both of the same size, and have the same figure and dispositions. They are both very agile, and their nimbleness and dexterity are extremely amusing. We have had them alive, and of all the sapajous their constitution seems to be best adapted to our climate. If kept in a chamber during the winter, they live comfortably for several years. We can even give several examples of their producing in this country. Two young ones were brought forth in M. de Pompadour's lodging at Versailles; one in the house of M. de Reaumur at Paris, and another in Mad. de Poursel's in Gatinois. But in this country they never produced above one at a time, while in their native climate they often produce two. Besides, these sajous are very whimsical in their taste and affections. They are fond of particular persons, and discover the greatest aversion to others.

[M. Sanches, formerly first physician to the court of Russia, communicated this last fact to me in a letter from Mad. de Poursel, of which the following is an extract: 'Bourdeaux, Jan. 26, 1764. On the 13th of this 'month the female sapajou brought forth a young one, 'whose head was almost as large as that of the mother. 'During two hours she suffered great pain; and we 'were obliged to cut the belt by which she was fixed, 'otherwise she could not have brought forth. Nothing 'could be more beautiful than to see the father and 'mother occupied with their little one, which they teazed 'incessantly, either by carrying it about, or by caressing 'it. *Fernambuco*, the name given to the male, because 'he was brought from that part of Brasil, loves his child 'to distraction. The father and mother carry it alternately; and when it does not hold properly they gave 'it a pretty severe bite.']

We remarked a singularity in these animals which makes the females be often mistaken for the males. The clitoris is prominent, and appears to be as large as the penis of the male.

Distinctive Characters of this Species.

The sajous have neither cheek-pouches, nor callosities on their buttocks. Their face and ears are flesh-coloured, with a little down above. The partition of the nostrils is thick, and their apertures are placed at a side, and not under the nose. The eyes are chesnut coloured, and situated near each other. The tail is prehensile, naked below at the point, and very bushy every where else. In some the hair is black and brown, both round the face and upon all the upper parts of the body. In others the hair round the face is gray, and of a brownish yellow on the body. The hands are always black and naked. From the point of the muzzle to the origin of the tail they exceed not a foot in length. They walk on four feet. The females are not subject to the menses.

THE SAI, OR WEEPER.

CAY, pronounced *sai*, the Brasilian name of this animal.

Monkey with a round and flat face, with a reddish brown colour, very deformed; the hair on the head and upper part of the body black, tinged with brown; beneath, and on the limbs, tinged with red; tail black, and much longer than the head and body: the young are excessively deformed; their hair very long, and thinly dispersed.—*Pennant.*

We have seen two varieties of this species; the first was of a blackish brown colour; and the second, which I have called *sai with a white throat*, has white hair on the breast, throat, and round the ears and cheeks. It differs from the first by having less hair on the face. But in every other article they perfectly resemble each other. Their dispositions, size, and figure, are the same. Travellers have mentioned these animals under the name of *weepers;* because they make a plaintive noise, and when irritated, have the appearance of crying. Others have called them *musk monkeys*, because, like the maucauco, they kave a musky odour. Others have given them the name of *macaque*, which they borrowed from the macaque of Guinea. But the macaques are monkeys with flaccid tails; while the former belong to the sapajous, because their tails are prehensile. The females have only two paps, and produce two young at a time. They are mild, docile, and so timid, that their common cry, which resembles that of a rat, becomes a kind of groaning when they are threatened with danger. In this country, they eat may-bugs and snails in preference to all other food. But, in Brasil, their native climate, they live chiefly on grains and wild fruits, which they gather from the trees, and rarely descend upon the earth.

[The cais or sais never remove from the top of a tree that bears fruit in a pod as large as our beans, which is their principal food. They assemble in troops, and particularly when it rains. It is pleasant to hear them chattering on the trees. The female produces but one at a time; and the young, as soon as brought forth, holds firm by the neck of its mother or father. When pursued by the hunters, they save themselves by leaping from branch to branch, carrying their young on their backs. The savages, therefore, being unable to seize either the young or the old, are obliged to wound them with arrows; after which they fall from the tops of the trees, either stunned or wounded. When cured of the wounds, and rendered somewhat tame, they are sold by the savages; for, when first taken, they are so ferocious, and bite so obstinately, that they quit not their hold till they be torn in pieces.—*Voyage de Lery.*]

Distinctive Characters of this Species.

The sais have neither cheek-pouches nor callosities on their buttocks. The partition of their nostrils is very thick, and the apertures are placed at a side, not under the nose. The face is round and flat, and the ears are almost naked. The tail is prehensile, and naked below toward its extremity. Upon the upper parts of the body, the hair is of a blackish brown colour, and on the inferior parts, of a pale yellow or dirty white. These animals exceed not fourteen inches in length; and their tail is longer than both body and head. They walk on four feet. The females are not subjected to the menses.

THE SAIMIRI, OR ORANGE MONKEY.

ORANGE monkey, with a round head, nose a little pointed, and the end of it dusky; orbits flesh-coloured; ears hairy: hair on the body short and fine, of a yellow and brown colour; but, in its native country, when in perfection, of a brilliant gold colour; the feet orange; nails of the hands flat, of the feet like claws; tail very long, and less useful for prehensile purposes than that of the rest; body of the size of a squirrel.—*Pennant.*

The saimiri is commonly known by the name of the *golden, orange,* or *yellow sapajou.* It is common in Guiana; and therefore has received from some voyagers the appellation of the *Cayenne sapajou.* From the gracefulness of its movements, the smallness of its size, the brilliant colour of its hair, the largeness and vivacity of its eyes, and its round visage, the saimiri has uniformly been preferred to all the other sapajous: it is indeed the most beautiful of this tribe. But it is likewise the most delicate, and the most difficult to transport and preserve. From these characters, and particularly from that of the tail, which is only half-prehensile, and, though not so muscular as that of the sapajous, is not absolutely useles and flaccid, the saimiri seems to form the shade between the sapajous and the sagoins.

Distinctive Characters of this Species.

The saimiri has neither cheek-pouches nor callosities on the buttocks. The partition of his nostrils is thick, and their apertures are placed at a side, not under the nose. He may be said to have no fore-head. His hair is of a brilliant yellow colour; and he has two flesh-coloured rings round his eyes. His nose is elevated at the base, and flattened at the point. The mouth is small, the face is flat and naked; and the ears are garnished with hair, and a little pointed. The tail is half-prehensile, and longer than the body. From the point of the muzzle to the origin of the tail, he exceeds not ten or eleven inches in length. He stands with ease on his two hind legs; but he commonly walks on four. The female is not subject to the menses.

THE SAKI, OR FOX-TAILED MONKEY.

FOX-tailed monkey, with a swarthy face, covered with short down; forehead and sides of the face with whitish and pretty long hair; body with long dusky brown hairs, white or yellowish at their tips; hair on the tail very long and bushy, sometimes black, sometimes reddish; belly and lower part of the limbs a reddish white. Length from nose to tail near a foot and a half, tail longer, and like to that of a fox: hands and feet black, with claws instead of nails.—*Pennant.*

The saki, which is commonly called the *fox-tailed monkey*, beacause its tail is garnished with very long hair, is the largest of the sagoins. When full grown, it is about seventeen inches long; but the largest of the other five species exceeds not nine or ten. The hair on the body of the saki is very long, and that on the tail is still longer. His face is reddish, and covered with a whitish down. He is easily distinguished from all the other sagoins, sapajous, and monkeys, by the following characters.

Distinctive Characters of this Species.

The saki has neither cheek-pouches nor callosities on his buttocks. His tail is flaccid, not prehensile, and one half longer than both head and body. The partition of the nostrils is very thick, and the apertures placed at a side. The face is tawny, and covered with a fine, short, whitish down. The hair on the upper parts of the body is blackish brown, and that on the belly and other inferior parts is reddish white. The hair on the body is still longer than that on the tail, beyond the point of which it hangs near two inches. The hair on the tail is generally blackish brown, like that on the body. This species seems to vary in colour. Some sakis have the hair both on the body and tail of a reddish yellow colour. This animal walks on four feet, and is near a foot and a half in length. The females are not subjected to the periodical evacuation.

THE TAMARIN, OR GREAT-EARED MONKEY.

GREAT-EARED monkey, with a round head, and a swarthy, flesh-coloured, naked face; upper lip a little divided; ears very large, erect, naked, and almost square; hair on the forehead upright and long; on the body, soft, but shaggy: the head, whole body, and upper part of the limbs, black, except the lower part of the back, which is tinged with yellow; hands and feet covered with light orange-coloured hairs, very fine and smooth; nails long and crooked; tail black, and twice the length of the body; teeth very white.—*Pennant.*

This species is much smaller than the preceding, and differs from it in several characters. The tail of the tamarin is covered with short hair, but that of the saki is garnished with hair remarkably long. The tamarin has also large ears, and yellow feet. It is a beautiful animal, very lively, and easily tamed, but so delicate that it cannot long resist the inclemency of our climate.

[In Cayenne, there are very small monkeys called *tamarins*, which are extremely beautiful. They exceed not the size of a squirrel, and have the head and face of a lion, small teeth as white as ivory, and arranged with great symmetry. They are black, with yellowish spots on the shoulders. The pats are like those of the monkey, and orange-coloured. They are very familiar and playsome.—*Antoine Binet.*]

Distinctive Characters of this Species.

The tamarin has neither cheek-pouches nor callosities on the buttocks. The tail is flaccid, and twice the length of the body and head. The partition between the nostrils is very thick, and the apertures are placed at a side. The face is of a dusky flesh-colour. The ears are square, large, naked, and of the same colour; and the eyes are chesnut. The upper lip is divided nearly like that of the hare. The head, body, and tail, are covered with soft, blackish, brown hair, and the hands and feet with short orange coloured hair. The body and limbs are finely proportioned. This animal walks on four feet; and the head and body together exceed not seven or eight inches in length. The females are not subject to the menses.

THE OUISTITI, OR STRIATED MONKEY.

OUISTITI is a sound articulated by this animal, and which we have adopted for its name.

The striated monkey, with a very round head. About the ears are two very full tufts of white hairs standing out on each side; irides reddish; face a swarthy flesh-colour; ears like the human; head black; body ash-coloured, reddish, and dusky, the last forms striated bars cross the body: tail full of hair, annulated with ash-colour and black; body seven inches long; tail near eleven; hands and feet covered with short hairs; fingers like those of a squirrel; nails, or rather claws, sharp.—*Pennant.*

The ouistiti is still smaller than the tamarin, both the head and body not exceeding half a foot in length. His tail is more than a foot long, and like that of the maucauco marked with alternate rings of black and white; the hair on the tail is still stronger and more bushy than that of the maucauco. The face of the ouistiti is naked, and of a dark flesh-colour. He has two tufts of long white hair before his ears, which conceal them when we look the animal in the face. Mr. Parsons has given a good description of this animal in the Philosophical Transactions; and Mr. Edwards, in his Gleanings, has given an excellent figure of it. He remarks, that of several he saw the largest weighed not above six ounces, and the smallest only four and a half; and judiciously adds, that the supposition that the small Æthiopian monkey, mentioned by Ludolph, under the denomination of *fonkes* or *guereza*, was the same animal with the ouistiti, has no foundation. It is certain, that neither the ouistiti nor any other sagoin exists in Æthipia; and the *fonkes* or *guereza* of Ludolph is probably the *maucauco* or *loris*, which are common in the southern regions of the Old Continent. Mr. Edwards farther remarks, that when the ouistiti is in good health its hair is very bushy; that one of those he saw, which was very vigorous, fed upon several things, as biskets, fruits, pot-herbs, insects, and snails; that one day being unchained, it darted upon a small gold-fish that was in a basin, which it killed and devoured with avidity; and that afterwards small eels were presented to it, which at first frighted it by twisting round its neck; but that it soon overcame and ate them. Mr. Edwards subjoins a fact, which proves that these small animals might be multiplied in the southern parts of Europe: he tells us, that they produced young in Portugal, where the climate is favourable to them. They are at first very ugly, having hardly any hair on their bodies; and they adhere firmly to the teats of the mother. When they have become a little larger, they fix themselves upon her back or shoulders; and when she is fatigued by carrying them she rubs them off against a wall, and the father instantly allows them to mount upon his back in order to assist the mother.

Distinctive Characters of this Species.

The ouistiti has neither cheek-pouches nor callosities on the buttocks. His tail is flaccid, very bushy, annulated with alternate bars of black and white, or rather of brown and gray, and twice as long as the head and body. The partition of the nostrils is very thick, and the apertures are placed at a side. The head is round. The top of the front is covered with black hair; and above the nose there is a white spot without hair. The face is likewise almost naked, and of a deep flesh colour. On each side of the head, before the ears, is a tuft of long white hairs. The ears are roundish, flat, thin, and naked. The eyes are of a reddish chesnut colour. The body is covered with gray ash-coloured hair, interspersed with a little yellow on the throat, breast, and belly. He walks on four feet; and often exceeds not half a foot in length. The females do not menstruate.

THE MARIKINA, OR SILKY MONKEY.

THE silky monkey, with a flat face, of a dull purple colour; ears round and naked; on the sides of the face the hairs very long, turned backwards, of a bright bay colour; sometimes yellow, and the former only in patches; the hair on the body long, very fine, silky, glossy, and of a pale bright yellow; hands and feet naked, and of a dull purple colour; claws instead of nails to each finger; length of the head and body ten inches; tail thirteen and a half, a little bushy at the end.—*Pennant.*

The marikina is commonly distinguished by the name of the small *lion-ape.* We reject this compound denomination, because the marikina is not an ape but a sagoin. Besides, he has no more resemblance to a lion than a lark has to an ostrich, there being no other relation between them than a kind of mane round the face of the marikina, and a tuft of hair at the end of his tail. His hair is long, silky, and vivid. He has a round head, a brown face, red eyes, and round naked ears, concealed under the long hairs which surround his face: these hairs are of a bright red colour, and those on the body and tail are pale yellow, almost white. This animal has the same manners, the same vivacity, and the same inclinations with the other sagoins. Its constitution seems to be more robust; for we have seen one that lived five or six years in Paris without any other precaution than keeping it during the winter in a warm room.

Distinctive Characters of this Species.

The marikina has neither cheek-pouches nor callosities on the buttocks. His tail is flaccid, or not prehensile, and almost twice as long as both the head and body. He has round naked ears, long reddish hairs around the the face, and bright yellowish white hairs, nearly of an equal length, on the rest of the body, with a considerable tuft at the extremity of the tail. He walks upon four feet; and exceeds not eight or nine inches in length. The female is not subject to the menses.

THE PINCHE, OR RED-TAILED MONKEY.

RED-TAILED monkey, with a round head and black pointed face; ears round and dusky; hair on the head white, long, and spreading over the shoulders: the shoulders and back are covered with long and loose brown hairs; rump and half the tail deep orange coloured, almost red; the remaining part black; the throat black; breast, belly, and legs white; insides of the hands and feet black; claws crooked and sharp; length of the head and body eight inches; tail above twice as long.—*Pennant.*

The pinche, though very small, is larger than either the ouistiti or the tamarin. Including head and body, it is about nine inches long, and the length of the tail is at least eighteen inches. It is rendered remarkable by a kind of smooth white hair upon the top and sides of the head, especially as this colour is wonderfully contrasted by that of the face, which is black, and interspersed with a gray down. The eyes are black, and the tail, from its origin to near the middle, is of a lively red, where it changes to a brownish black, which continues to the point. The hair on the superior parts of the body is of a yellowish brown colour; that on the breast, belly, hands, and feet, is white. The whole skin is black. The throat is naked and black, like the face. Though its figure be singular, it is a beautiful animal. Its voice is soft, and rather resembles the chanting of a small bird than the cry of a quadruped. It is extremely delicate and requires great precautions to be transported from America to Europe.

[In Brasil, de Lery remarks, there is a marmot which the savages call *sagoin.* It exceeds not the size of a squirrel, and is of the same reddish colour. Its muzzle resembles that of the lion. It is one of the most beautiful animals I have ever seen; and if it were as easily transported as the monkey it would be much more esteemed. It is so delicate that it cannot endure the motion of a ship; and, besides, it is so haughty that the smallest affront makes it die of chagrin.—*Jean de Lery.*]

Distinctive Characters of this Species.

The pinche has neither cheek-pouches nor callosities on the buttocks. His tail is not prehensile, and is more than twice the length of the head and body. The partition of the nostrils is thick, and the apertures are placed at a side. The face, throat, and ears, are black;

on the head are long white hairs. The muzzle is broad, and the face round. The hair on the body is pretty long, of a yellowish brown or reddish colour till near the tail, where it becomes orange; on the breast, belly, hands, and feet, it is white, and shorter than on the body. The tail, from the origin to one half of its length, is a vivid red, then brownish red, and toward the point it is black. He is about nine inches in length, and walks on four feet. The females are not subject to the menstrual evacuation.

THE MICO, OR FAIR MONKEY.

THE fair monkey, with a small round head; face and ears of the most lively vermilion colour; body covered with most beautiful long hairs of a bright and silvery whiteness, of matchless elegance; tail of a shining dark chesnut; head and body eight inches long; tail twelve.—*Pennant.*

We owe our knowledge of this animal to M. de la Condamine, and therefore we shall transcribe the account he has given of it: 'The monkey, of which the governor of Para made me a present, is the only one of 'the kind that had been seen in this country. The hair 'on its body was of a beautiful silvery white colour; 'and that on its tail was a shining chesnut approaching 'to black. Its ears, cheeks, and muzzle, were of so 'lively a vermilion, that it had the appearance of being 'the work of art. I kept it twelve months; and when 'almost in sight of the French coast it was still alive. 'But notwithstanding all my precautions to defend it 'against the cold, it fell a victim to the rigour of the 'season before my arrival. I have preserved it in aquavitæ, which will be sufficient to show that my description is not exaggerated.' From this relation it is obvious, that M. de la Condamine's description will apply to no other animal than the *mico;* and that it is a distinct, and probably a very rare species. Though remarkable for the beauty of its hair, and the lively red which adorns its face, it was never mentioned by any former author or traveller.

Distinctive Characters of this Species.

The mico has neither cheek-pouches nor callosities on the buttocks. The tail is about one half longer than the head and body, and is not prehensile. The partition of the nostrils is thinner than that of the other sagoins; but their apertures are placed at a side. Its face and ears are naked, and of a vermilion colour. The muzzle is short; the eyes are distant from each other; the ears are large; the hair is of a beautiful silvery white colour, and that of the tail of a glossy brown, approaching to black. It walks on four feet, and exceeds not seven or eight inches in length. The females are not subject to the menses.

Notices of some Animals which are not expressly treated of in the course of this Work.

We have now finished, according to the extent of our ability, the history of quadrupeds. But to render it still more complete, those of which we could not procure an exact knowledge must not be passed over in silence. Their number is small; and even of this small number, several of them are only varieties of the species already described.

I. THE WHITE OR POLAR BEAR.

POLAR bear, with long head and neck; short round ears; end of the nose black; vast teeth; hair long, soft, white, and tinged in some parts with yellow; limbs of great size and strength. It grows to a vast size, the skins of some being thirteen feet long.

The white bear is a famous animal in our most northern regions. It is mentioned by Martin and some other voyagers. But none of their descriptions are so complete as to enable us to ascertain whether it differs in species from the common bear. If what they have said, however, be exact, it is probably a distinct species. But as we know that the wolf varies in different climates, some of them being black, others brown, others white, and others variegated, colour is a character of no value in constituting different species. I saw two small bears which had been brought from Russia, and were entirely white: and yet they were unquestionably of the same species with our Alpine bears. These animals likewise vary greatly in size. As they live long, and become very thick and fat in places where they have plenty of nourishment, and are not disturbed, the character drawn from magnitude is equivocal. Hence we are not authorised to conclude, that the bear of the northern seas is a peculiar species, solely because he is white and larger than the common kind. The difference of habits seems not to be more decisive than that of colour and magnitude. The bear of the northern seas feeds upon fishes. He never quits the margins of the sea, and often inhabits the floating islands of ice. But if we consider that the bear is an animal which eats every thing, that when pressed with hunger he has no choice, and that he is not a afraid of water, these habits will not appear sufficient to form distinct species. The fish eaten by the sea-bears is rather a kind of flesh, being chiefly the carcases of whales, walruses, and seals. The climate produces no other animals. Neither does it afford grain or fruits; and consequently the bear is under the necessity of subsisting on the productions of the sea. Is it not probable that our bears, if transported to the mountains of Spitzbergen, and finding no food upon land, would take to the sea in quest of subsistence?

Colour, size, and mode of living, being insufficient, no other essential characters remain but those which may be derived from figure. Now, all that voyagers have said of the sea-bear amounts only to this, that his head, body, and hair are longer than those of our bear, and that his skull is much harder. If these differences were real and considerable, they would be sufficient to constitute a separate species. But I am not certain that Martin has examined with accuracy, and that the other writers who copied him, have not exaggerated. ‘These white bears,’ he remarks, ‘are quite otherwise shaped than those that ‘are seen in our country; they have a long head like ‘unto a dog, and a long neck, and they bark like dogs ‘that are hoarse, and all their whole body is much ‘otherwise shaped than ours. They are slender in the ‘body, and a great deal swifter.’ This description furnishes the following remarks: 1. That the author does not make these bears larger than ours; and consequently we ought to suspect the evidence of those who tell us that the sea-bear is sometimes thirteen feet in length. 2. That hair as soft as wool is not a specific character; for, to render hair soft, and even more bushy, it is only necessary that an animal be frequently in the water, as appears from the land and water beavers. The latter, who dwell oftener in the water than on land, have coarser and less bushy hair: and I am inclined to think, that the other differences are neither real nor so conspicuous as Martin would have us to believe; for Dithmar Blefken, in his description of Iceland, mentions these bears, and assures us, that he saw one killed in Greenland, which raised itself on the two hind feet, like our bears; but he says not one word which indicates that the white bear of Greenland is not entirely similar to ours. Besides, when these animals find prey on land, they never go to sea in quest of food. They devour rain-deer, and such other animals as they can seize. They even attack men, and never fail to dig up dead bodies. But hunger, which they often feel in these desert and barren lands, obliges them to frequent the water, in quest of seals, young walruses, and whales. They take up their residence on islands of ice, on which they are often seen floating, and never abandon their station as long as they can find abundance of food. When these boards of ice are detached in the spring, the bears allow themselves to be carried along; and, as they cannot regain the land, or abandon the ice on which they are embarked, they often perish in the open sea. Those who arrive with the ice on the coasts of Iceland or Norway, are starved to such a degree, that they devour every thing they meet, which may have given rise to the prejudice, that these sea-bears are more fierce and voracious than the common kind. Some authors tell us, that the sea-bears are amphibious like the seals, and that they can live as long as they please under water. But the contrary is evident from the manner of hunting them: They are incapable of swimming long, and never accomplish above a league at a time. They are followed by a small boat, and are soon worn out with fatigue. If they could dispense with respiration, they would dive to the bottom, in order to rest themselves. But when they dive, it is only for a few seconds; and for fear of drowning, they allow themselves to be killed on the surface of the water.

Seals are the common prey of the white bears. But the walrus, from whom they sometimes carry off the young, pierces them with its tusks, and puts them to flight. The whale likewise overwhelms them by its weight, and banishes them from the places they frequent. They sometimes, however, devour the young whales. All bears are naturally very fat; and the white bears, which live upon animals loaded with grease, are fatter than the common kind. Their fat is very like that of the whale, the flesh of these bears is not bad, and their skin makes a very warm and durable fur.

SUPPLEMENT.

I here give a figure of the white sea-bear, from a drawing sent me by the late Mr. Colinson. If this drawing be exact, it is certain that the sea-bear is a different species from the land-bear. The head is so long, when compared with that of the common bear, that this character alone is sufficient to constitute a distinct species: and those voyagers adhere to truth when they tell us, that the figure of the sea-bear, is totally different from ours, and that its head and neck are much longer. From the drawing it likewise appears, that the feet, instead of resembling the human hand, like those of the land-bear, are formed nearly like the feet of a large dog, and other carnivorous animals of this kind. Besides, from several relations, it appears, that some of these bears are much larger than the land-bear. Gerard de Viera asserts, that, after killing one of these bears, he measured the skin, and found it to be twenty-three feet long, which is more than triple the length of the common bear. We likewise find from the Collection of Voyages to the North, that these sea-bears are larger and more ferocious than ours. But in the same Collection, it is said, that, though these bears are differently formed, and have the head and neck much longer, and the body more slender and agile, they are nearly of the same size with the common kind.

All voyagers likewise agree, that the sea-bears, have the bones of the head so hard, that no blow of a club, though sufficient to bring an ox to the ground, can stun them; and that their voice rather resembles the barking of an enraged dog than the deep murmuring cry of the common bear. Robert Lade assures us, that, in the environs of the river Rupper, he killed two sea-bears of a prodigious size; that these famished and ferocious animals attacked the hunters with such impetuosity, that they killed several Savages, and wounded two Englishmen. In page 34 of the third Dutch Voyage to the North, we are told, that the sailors killed, on the coast of Nova Zembla, a sea-bear whose skin was thirteen feet long. Upon the whole, therefore, I am inclined to believe, that this animal, so much celebrated for its ferocity, is really a much larger species than our bear.

II.

THE COW OF TARTARY.

M. Gmelin, in the New Memoirs of the Academy of Petersburg, has given a description of a Tartarian cow, which, at first sight, appears to differ from all those we have enumerated under the article *buffalo*. 'This cow,' says he, 'which I saw alive, and had a drawing made of it in Siberia, came from Calmuck. It was about two and a half Russian ells in length. By this standard we may judge of its other dimensions, the proportions of which have been accurately observed by the painter. The body resembles that of a common cow. The horns are bended inward. The hair on the body and head is black, except on the front and ridge of the back, where it is white. It has a mane on the neck; and the whole body, like that of a buck, is covered with very long hair, which descends as far as the knees, and makes the legs appear short. It has a bunch on the back. The tail resembles that of a horse, and is white and very bushy. The fore legs are black, the hind ones white, and the whole resemble those of the ox. Upon the heels of the hind feet, there are two tufts of long hair, the one before and the other behind; and on the fore feet, there is but one tuft behind. The excrements are more solid than those of cows; and, when the animal discharges urine, it draws its body backward. It lows not like an ox, but grunts like a hog. It is wild, and even ferocious; for, except the man from whom it receives its food, it gives blows with its head to every person who comes near it. The presence of domestic cows it hardly suffers: whenever it perceives one of them, it grunts, which it seldom does on any other occasion.' To this description M. Gmelin adds, 'That it is the same animal mentioned by Rubruquis in his travels into Tartary: that there are two species of it among the Calmucks, the first called *Sarluk*, which I have already described, and the second *Chainuk*, which differs from the others by the largeness of its head and horns, and also by the tail, which at its origin resembles that of the horse, and terminates like that of a cow. But they both have the same natural dispositions.'

In the whole of this description, there is only a single character which indicates the Calmuck cows to be a particular species, and that is their grunting instead of lowing. In every other article, they have so strong a resemblance to the bison, that they must belong to the same species, or rather the same race. Besides, though the author says, that these cows do not low, but grunt, he acknowledges that they very rarely utter that kind of sound. Perhaps it was an affection peculiar to the individual he saw; for Rubruquis, and the other writers whom he quotes, do not mention this grunting. Perhaps the bisons, when enraged, likewise make a grunting noise. Even our bulls, particularly in the rutting season, have a hollow, interrupted voice, which has a greater resemblance to grunting than to lowing. I am persuaded, therefore, that this grunting cow of Gmelin is nothing else but the bison, and does not constitute a particular species.

III.

THE TOLAI, OR BAIKAL HARE.

Baikal hare, with a tail somewhat longer than that of a rabbit; fur of the colour of the common hare; red about the neck and feet; tail black above, white beneath.

It is larger than a rabbit, and inhabits the country beyond Lake Baikal.

This animal is very common in the neighbourhood of Lake Baikal in Tartary. It is somewhat larger than the rabbit, which it resembles in the figure of the body, the fur, the gait, the colour, the taste of the flesh, and the habit of digging a retreat in the earth. Their internal structure is likewise the same; and there is no difference but in the length of the tail, that of the tolai being considerably longer. Hence it is extremely probable, that animal is only a variety in the species of the rabbit. Rubruquis, when treating of the animals in Tartary, says, 'There are rabbits with a long tail, and black and 'white hairs at the point. There are no stags, few hares, 'a vast number of gazelles,' &c. This passage seems to insinuate, that our short-tailed rabbit is not found in Tartary, or rather, that it has undergone some variations in that climate, and particularly in the length of the tail; for as the tolai resembles the rabbit in every other respect, it is unnecessary to consider them as belonging to different species.

IV.

THE ZISEL, OR EARLESS MARMOT.

Marmot without external ears, having only a small orifice on each side of the head for the admittance of sounds. It has a blunt nose, a long slender body, and a very short tail. The colour is dark gray, or cinereous brown.

Some authors, and among others Linnæus, have doubted whether the *zisel* or *zeisel* (*citelus*) be a different animal from the hamster (*cricetus*). They have indeed a great resemblance to each other, and inhabit nearly the same countries. They differ, however, in so many characters, that I am convinced they constitute two distinct species. The zisel is smaller than the hamster. Its body is long and slender like the weasel; but that of the hamster is thick like the rat. It has no external ears, but two auditory passages concealed under the hair. The ears of the hamster are short; but they are round and very conspicuous. The zisel is of a uniform cinereous gray colour; but the hamster has three large white spots on each side of the breast. These differences, when joined to this circumstance, that the two animals, though they inhabit the same regions, never intermix, are sufficient to remove every doubt with regard to the diversity of their species, though they resemble one another in the shortness of the tail and legs, in having teeth like those of the rat, and even in natural habits, such as, digging retreats in the earth, laying up magazines of provisions, destroying the corn, &c. Besides, what must remove every doubt on this subject, Agricola, an exact and judicious writer, in his Treatise on Subterraneous animals, gives a description of both these animals, and distinguishes them so clearly that it is impossible to confound them. Hence we may conclude, that the hamster and zisel are very different species, and perhaps as remote from each other as the weasel from the rat.

V.

THE ZEMNI, OR PODOLIAN MARMOT.

Podolian marmot, with the cutting teeth of the lower jaw half as long again as those of the upper; eyes very minute, and as much hid in the fur as those of the mole; four toes, and a claw instead of the fifth, on the fore feet; five on the hind; tail short; colour cinereous; size of a squirrel.

In Poland and Russia there is another animal called *ziemni* or *zemni*, which is of the same genus with the *zisel*, but larger, stronger, and more mischievous. The head is pretty thick, the body slender, and the ears short and rounded. It has four large cutting teeth, which project out of the mouth, the two in the under jaw being thrice as long as the two in the upper. The feet are very short, covered with hair, divided into five toes, and armed with crooked claws. The hair is soft, short, and of a mouse-gray colour. The tail is of a moderate size. The eyes are as small, and equally concealed as those of the mole. Rzaczinski gives it the denomination of the *little earth dog*. This author seems to be the only one who mentions the zemni, though it be very common in some of the northern provinces. Its natural dispositions and habits are nearly the same with those of the hamster and zisel. It bites cruelly, eats voraciously, and lays waste the corn fields and gardens. It digs a habitation in the earth, and feeds upon grains, fruits, and pot-herbs, of which it lays up magazines in its retreat, where it passes the winter.

VI.

THE POUC.

Rzaczinski mentions another animal which is larger than the domestic rat, and called *pouch* by the Russians. It digs a retreat in the earth, and lays waste the gardens. This animal was so numerous near Suraz in Volhinia, that the inhabitants were obliged to abandon the culture of their gardens. It is perhaps the same with Seba's *Norwegian rat*, of which he gives a figure and description.

VII.

THE PEROUASCA.

Russia and Poland furnish another animal. In the language of the former country it is called *perewiazka*, and in that of the latter *przewiaska,* or *girdled weasel.* It is smaller than the polecat, and covered with whitish hair, rayed transversely with several bands of yellowish red. It lives in the woods, and burrows in the ground. Its skin is a beautiful fur.

VIII.

THE SOUSLIK, OR CASAN MARMOT.

In Casan and the provinces watered by the Wolga, as far as Austria, there is a small animal called *souslik* in the Russian language, which furnishes a beautiful fur. In figure and shortness of tail it has a great resemblance to the short-tailed field mouse. But it is distinguished from the mouse or rat kind by its fur, which is every where interspersed with small spots of a bright and shining white. These spots exceed not a line in diameter, and are placed at the distance of two or three lines from each other. They are more conspicuous and better defined, upon the loins than on the shoulders and head. Mr. Pennant, a well known and very able naturalist, favoured me with one of these sousliks, which had been transmitted to him from Austria, as an animal unknown to the naturalists. I recognised it to be the same animal with that of which I had a skin in my possession, and of which M. Sanchez sent me the following notice: 'Great numbers of the rats called sousliks are taken in 'the barks loaded with salt in the river Kama, which 'descend from Solikamski, where there are salt pits, 'and fall into the Wolga, above the town of Casan, at 'the confluence of the Teluschin. The Wolga, from 'Simbuski to Somtof, is covered with these salt barks; 'and it is in the lands adjacent to these rivers, as well 'as in the barks, where the sousliks are taken. They 'have obtained the denomination of *souslik,* which sig'nifies *nice-tasted,* because they are extremely fond of 'salt.'

SUPPLEMENT.

I now give a figure of this animal, which is not in the original work. Prince Galitzin, at the desire of M. de Buffon, was so obliging as to send eight sousliks, with the necessary precautions for preserving them alive, till they should arrive in France. These eight animals arrived in Petersburgh, after a long journey from Siberia. But notwithstanding all the attention paid to them they died in passing from Petersburg to France. The instructions from Siberia were, to feed them only with grain or hempseed; to give them as much air as possible; to put a considerable quantity of sand in their cage, because in their natural state they burrow in light soils.

These animals generally dwell in the deserts, and dig holes in the declivities of the mountains, provided the earth be blackish. Their holes are not of equal depths, and are seven or eight feet long, never straight, but winding, and have from two to five entries, the distances of which are unequal, being from two to seven feet asunder. In these holes they make different apartments, and amass in them their winter provisions during the summer. In the cultivated fields they collect ears of corn, pease, lint, and hemp seeds, and place them separately in different departments of their holes. In uncultivated lands they collect the seeds of various herbs. During summer they feed upon grains, herbs, roots, and young mice; for when the mice are large, the souslik is unable to kill them. Beside their magazines of provisions, these animals dig separate holes some feet distant from the former, in which they repose. They throw all their ordure out of their retreats. The females bring forth from two to five young at a litter, which are blind and naked, and begin not to see till after the hair appears. The time of gestation is not exactly known.

IX.

THE SIBERIAN OR GILDED MOLE.

In Siberia there is a mole called the *gilded mole,* whose species is probably different from the common kind; because it wants the tail, has a very short muzzle, the hair mixed with green and a gold colour, and only three toes on the fore feet, and four on those behind, while the common mole has five toes on all the feet. We are ignorant of the proper name of this animal.

X.

THE WHITE WATER RAT.

The water rat of Europe is found in Canada; but its colours are different. It is brown on the back; and the rest of the body is white, and in some places yellow. The head, muzzle, and end of the tail, are white. The hair is softer and more glossy than that of our water rat. But in every other article these animals are perfectly similar, and undoubtedly belong to the same species. The white hair is an effect of cold; and it is probable, that white water-rats may be found in the north of Europe as well as in Canada.

XI.

THE GUINEA HOG.

Though this animal differs from the common hog in some characters, I presume that it is the same species, and that these differences are only varieties produced by the influence of climate. Of this we have an example in the Siam hog, which likewise differs from that of Europe; and yet it is unquestionably the same species, since they intermix and produce together. The Guinea hog is nearly of the same figure with ours, and of the same size with the Siam hog, that is, smaller than the wild boar or the domestic hog. It is an original native of Guinea, and has been transported to Brasil, where it has multiplied prodigiously. It is domestic, and perfectly tame. It has short, red, shining hair, and no bristles, even on the back. The neck and crupper, near the origin of the tail, are covered with longer hairs than those on the rest of the body. Its head is not so large as that of the European hog, from which it differs in the figure of the ears, which are very long, sharp-pointed, and lie back upon the neck. Its tail is also much longer, reaching near the ground, and entirely destitute of hair. This race, which, according to Marcgrave, is peculiar to Guinea, is found likewise in Asia, and particularly in the island of Java, from whence they seem to have been transported by the Dutch to the Cape of Good Hope.

XII.

THE ETHIOPIAN OR CAPE VERD BOAR.

Ethiopian hog with small tusks in the lower jaws; very large ones in the upper, in old boars bending up towards the forehead in form of a semicircle; no fore teeth; nose broad, depressed, and almost of a horny hardness; head very large and broad; beneath each eye a hollow, formed of loose skin, very soft, and wrinkled; under these a great lobe or wattle, lying almost horizontal, broad, flat, and rounded at the end, placed so as to intercept the view of any thing below from the animal. Between these and the mouth, on each side, a hard callous protuberance; mouth small; skin dusky; bristles disposed of in *fasciculi* about five each; longest between the ears and on the beginning of the back, and but thinly dispersed on the rest of the back. Ears large and sharp-pointed, inside lined with long whitish hairs; tail slender and flat; does not reach lower than the thighs, and covered with hairs disposed in *fasciculi*.

In the neighbourhood of Cape Verd there is another hog or boar, which, from the number of his teeth, and the enormous size of the tusks in his upper jaw, appears to be a peculiar race, if not a different species from that of all the other hogs, and approaches toward the babiroussa. These tusks have a greater resemblance to ivory horns than to teeth. They are half a foot long, five inches in circumference at the base, and bended nearly like the horns of a bull. This character alone is not sufficient to constitute a difference in species. But what supports this presumption, he likewise differs from all other hogs in the length of the aperture of his nostrils, in the great breadth and figure of his jaws, and in the number and form of his grinders. However, we have seen the tusks of a wild boar, which was killed in the woods of Burgundy, and made an approach to the Cape Verd boar: its tusks were about three inches and a half long, and four inches in circumference at the base. They had also a double bend, like the horns of a bull. They appeared likewise to consist of solid ivory; and it is certain that this boar must have had larger jaws than the common kind. Hence we may presume, that the Cape Verd boar is only a simple variety, a particular race, in the species of the common hog.

SUPPLEMENT.

We formerly suggested that the wild boar of Cape Verd appeared to be a different race, and perhaps a different species from all the other hogs. The celebrated M. Allamand, professor of Natural History at Leyden, was kind enough to send us an engraving of this animal, and afterwards wrote to M. Daubenton in the following terms:

‘ I believe, Sir, that the wild boar represented in the ‘ plate which I sent you is the same with that pointed ‘ out by you under the denomination of the *wild boar of* ‘ *Cape Verd*. This animal is still living (May 5, 1767) ‘ in the menagerie of the Prince of Orange. I visit him ‘ occasionally, and always with fresh pleasure. I cannot help admiring the singular form of his head. I ‘ have written to the Governor of the Cape of Good ‘ Hope, begging him, if possible, to transmit me another. But of this I have little hope; because even at ‘ the Cape it was regarded as a monster, which had never ‘ hitherto been seen by any person. If however I succeed in my request, I shall send the animal to France, ‘ that you and M. de Buffon may have an opportunity ‘ of examining it. We tried to make the one in our ‘ possession copulate with a sow; but as soon as she ‘ was presented to him, he darted upon her with fury, ‘ and tore her to pieces.’

We have copied the engraving transmitted to us by M. Allamand. M. Pallas, and M. Vosmaer, have used the same figure, and each of them have given a description of this animal. M. Allamand, in his letter to M. Daubenton, dated at Leyden, October 31, 1766, remarks, that the head is the most singular part of this boar, which chiefly differs from that of our hogs by two uncommon appendixes, in the form of ears, at the side of each eye.

We shall here remark, that the disdain and cruelty, mentioned by M. Allamand, of this wild boar to the sow when in season, seems to prove it to be a different species from our hogs. A farther proof arises from the difference in the form of the head, both external and internal. However, as it approaches the hog much nearer than any other animal, and as it is found not only in the neighbourhood of Cape Verd, but not very distant from the Cape of Good Hope, we shall call it the *African boar*, and give the history and description of it from the writings of Pallas and Vosmaer.

Vosmaer calls it the *wild African boar*, or the *boar with a large snout*, and distinguishes it with propriety from the Guinea hog with long pointed ears, from the American pecari, and from the Indian babiroussa.

'M. de Buffon,' he remarks, 'speaking of a part of 'the jaws, the tail and feet of a singular wild boar of 'Cape Verd, preserved in the royal cabinet, says, that 'it has cutting teeth: but no such teeth appear in our 'subject.'

Hence M. Vosmaer insinuates that it is not the same animal. We have seen, however, that M. Allamand and I agree, that this Cape de Verd boar, of which I had an opportunity of examining a part of the head only, is found, notwithstanding, to be the same large snouted hog which M. Vosmaer said was unknown to all the naturalists.

M. Tulbagh, Governor of the Cape of Good Hope, who transmitted this wild boar to Europe, writes, that it was taken between Caffraria and the country of the great Namaquas, about two hundred leagues from the Cape, and that it was the only one of the species which had been seen there alive. M. Vosmaer likewise received the skin of an animal of the same species, which appeared to differ in some particulars from the live animal.

This animal was kept in a cage; 'and as I was informed,' M. Vosmaer remarks, 'that he was not mischievous, I opened the door of his cage. He came 'out without showing any marks of rage. He gaily 'frisked about in quest of food, and greedily devoured 'whatever was given him. Having left him alone for a 'few moments, I found him on my return busy in digging the earth, where, notwithstanding the pavement was 'made of small bricks well cemented, he had already made 'a hole of incredible size, with a view, as we afterwards 'discovered, to reach a common sewer which passed 'below at a great depth. I caused his labour to be interrupted; and it was not without much trouble, and 'the assistance of several men, that we could overcome 'his resistance, and make him return to his cage. His 'resentment was expressed by sharp and mournful cries. 'He seems to have been taken in the African woods 'when he was very young; for he has grown considerably since his arrival in Europe, and is still alive (1767). 'He passed the last winter very well, though the frost 'was severe, and he was confined during the greatest 'part of that season.

'In agility he exceeds the hogs of this country. He 'freely allows himself to be stroaked with the hand, 'and even with a stick. He seems to be pleased with 'rough friction; for it was by this means that we made 'him remain quiet when the painter drew his picture. 'When provoked or rudely pushed he retires backward, 'always facing the assailant, and shaking or striking 'forcibly with his head. When let loose after long 'confinement he is very gay, leaps, and pursues fallow 'deer and other animals. On these occasions he erects 'his tail, which is commonly pendulous. He emits a 'strong odour, which is not disagreeable; but I cannot 'compare it to any other smell. When I stroaked him 'with the hand this odour approached to that of a new 'cheese. He eats all kinds of grains. His food, when 'on shipboard, was maize, and as much fresh herbage 'as could be procured. But after he had tasted barley 'and European wheat, with which other animals in our 'menagerie are fed, he preferred this kind of food, and 'roots dug out of the earth. He was so fond of rye-bread that he followed any person who had a piece of 'it. When he eats or drinks, he supports himself on the 'knees of his fore feet; and he often rests in this position. His senses of hearing and smelling are very 'acute; but his sight is limited by the smallness and 'situation of his eyes, which prevent his seeing objects 'around him, because they are placed higher and nearer 'each other than in other hogs, and there are two large 'excrescences at the sides and below the eyes. He has 'more sagacity than the common hog.

'The figure of the head is terrible. The flatness and 'breadth of the nose, joined to the length of the snout, 'the singular excrescences rising from the sides of the 'eyes, and the strong tusks, give to the animal a monstrous aspect. The length of the body is about four 'Rhenish feet.

'In figure he makes a near approach to that of the 'domestic hog: he appears to be smaller, his back being 'flatter, and his legs shorter.

'When compared with other hogs, his head is deformed both in figure and dimensions. The muzzle is 'large, flat, and very hard. The nose is moveable, a 'little bended laterally toward the base, and terminates 'obliquely. The nostrils are large, distant from each 'other, and appear only when the head is raised. The 'upper lip is hard, and thick at the side. Round the 'tusks it is prominent and pendulous, forming behind 'them a kind of oval cartilaginous protuberance, which 'covers the corners of the muzzle.

'This animal wants fore teeth both above and below; 'but the gums are smooth, rounded, and hard.

'The tusks of the upper jaw are an inch thick at the 'base, crooked, and project out of the mouth five inches 'and a half, and terminate in an obtuse point. On the 'side of each of them there is a kind of furrow. Those 'of the under jaw are much smaller, less crooked, and 'almost triangular. By continual friction against the 'upper tusks they appear to be cut obliquely. We were 'prevented from examining the grinders by the furious 'resistance of the animal.

'In proportion to the head the eyes are small, placed 'higher, and nearer each other and the ears, than in the 'common hog. The iris is of a deep brown colour, and 'the cornea white. The upper eye-lids are garnished 'with brown, stiff, erect, and very close ciliæ, which are 'longer in the middle than at the two sides. There are 'no ciliæ on the under eye-lids.

'The ears are pretty large, more round than pointed, 'covered on the inside with close yellow hair, and bend 'back toward the animal's body. Under the eyes there 'is a kind of bulbous or glandular sac; and immediately below that appear two round, flat, thick, and horizontal excrescences, about two inches and a quarter 'in diameter. In a straight line between these excrescences and the muzzle there is on each side of the head 'a hard, round, sharp protuberance.

'The skin seems to be very thick, filled with lard in 'the ordinary places, but flaccid on the neck, groin, and 'dewlap. In some places it appears to be slightly furrowed, unequal, and as if the upper part of it fell off 'by intervals. Thinly dispersed over the body are 'some tufts of hairs, consisting of three, four, or 'five, longer and shorter, and placed in a straight line 'near one another. The front, and between the ears, 'seem to be wrinkled, and are adorned with very close, 'white, and brown hairs. From thence, toward the base 'of the muzzle, descends a narrow band of black and 'gray hairs, which, separating in the middle, fall upon 'each side of the head. On the nap of the neck, and 'the anterior part of the back, the bristles are longest 'and closest: their colour is a dusky brown and gray. 'Some of them are seven or eight inches long: in 'thickness they exceed not those of the common hog, 'and they split in the same manner. These bristles are 'not straight, but slightly inclined. Upon the back 'their number is so small that the skin appears to be 'naked. The flanks, breast, belly, and sides of the head 'and neck, are garnished with small white bristles.

'The feet, like those of our hogs, are divided into 'two black pointed hoofs. The tail is naked, hangs 'perpendicularly, and terminates almost in a point.

'The colour of the head is blackish; but that of the 'back and belly is a bright reddish gray.'

Notwithstanding these differences pointed out by M. Vosmaer, and the repugnance which this boar discovered to the sow that was presented to it, I am uncertain whether it is not a variety only of our European hog. This species varies greatly in Asia, Siam, and China. My uncertainty is increased by having found, about thirty years ago, an enormous head of a wild boar that was killed in my own woods, the tusks of which were nearly as large as those of the Cape boar.

Besides, M. Comerson informs me, that there are wild boars in Madagascar, whose head, from the ears to the eyes, is of the ordinary form; but that below the eyes is a protuberance which gradually tapers to the end of the snout, so that the animal appears to have two heads, the half of the one sunk into the other. The flesh of this hog is slimy and insipid. This information made me suspect, that the animal I had first mentioned under the denomination of the *wild boar of Cape Verd*, because its head was brought from the neighbourhood of that Cape, and afterwards called it the *wild African boar*, because it exists in the neighbourhood of the Cape of Good Hope, is likewise found in the island of Madagascar.

Addition by Professor Allamand.

M. de Buffon, in his history of the hog, has shown, that he eludes all those methodical disttributions into classes and genera, the distinguishing characters of which are derived from particular parts of the body. Though his reasons are not to be answered, they would have acquired additional force, if he had been acquainted with the animal under consideration. It is a wild boar sent from the Cape of Good Hope, in the year 1765, to the menagerie of the prince of Orange, which has hitherto been unknown to the naturalists. Beside the many singularities which make the European hog a detached species, this animal exhibits fresh anomalies, which distinguish him from all the other varieties of the same genus; for the figure of his head is not only different, but he has no cutting teeth, from which most of our nomenclators have drawn their distinctive characters, though the number of the teeth is by no means uniform, even in our domestic hogs.

To M. Tulbagh, governor of the Cape of Good Hope, who misses no opportunity of transmitting to Europe the curious productions of that country, we are indebted for this wild boar. In his letter he remarks, that this animal was taken about two hundred leagues from the Cape, and that it was the first which had ever been seen there alive. The last year, however, he sent another, which is still living; and in 1767 he transmitted a skin, of which we have only been able to preserve the head. These circumstances seem to indicate, that this animal is not rare in its native country. I know not whether Kolbe means to speak of these boars in the following passage. 'In the country occupied by the Dutch we 'rarely meet with *wild hogs:* As there are few woods, 'which are their common retreats, they have no motive 'to frequent these territories. Besides, the lions, tigers, 'and other rapacious animals, prevent the multiplication 'of the hogs, by devouring great numbers of them.' He adds no description; and therefore no conclusion can be drawn. Besides, he ranks among the number of Cape hogs the large ant-eater, which is an American animal, and has no resemblance to the hog. What credit is due to an author so ill informed?

The body of our African boar resembles that of the European kind: but it differs widely in the form of the head, which is of an enormous size. The most conspicuous objects are the large tusks which spring from each side of the upper jaw, and are directed almost perpendicularly upward. They are near seven inches long, and terminate in a blunt point. Two similar tusks, but smaller and thinner, rise from the under jaw, and apply themselves exactly to the external side of the superior tusks when the mouth is shut. These are powerful arms, which he may use to advantage in his native country, where he must be often exposed to the attacks of carnivorous animals.

His head, which is large and flat before, terminates in an ample snout, nearly equal in diameter to the breadth of the head, and of a hardness which approaches to that of horn. He uses it, like our hogs, in digging the earth. His eyes are small, and situated so far forward in the head, that he can only see straight before him. They are nearer each other and the ears, than in our European boars. Below the eyes there is a depression in the skin, which forms a kind of wrinkled sac. The inside of his ears are closely covered with hair. A little lower, and near the sides of the eyes, the skin rises and forms two excrescences, which, when viewed at a certain distance, have a perfect resemblance to a couple of ears, being of the same figure and size, and though not moveable, they lie nearly in the same plane with the forehead. Still lower, between these excrescences and the tusks, there is a large wart on each side of the head. It is easy to perceive, that a configuration of this kind must give a very singular aspect to the animal. When viewed in front, we think we see four ears upon a head which has no resemblance to that of any known animal, and inspires terror by the largeness of its tusks.

Pallas and Vosmaer, who have given good descriptions of this boar, tell us, that when he arrived in Holland he was very mild and tame; that as he had been several months on board the vessel, and had been taken young, he was become almost domestic; but that when pursued by strangers, he retired slowly backward, and presented his front with a menacing air; and even those who were daily near him were not without apprehensions of danger. One day he conceived a resentment against his keeper, whom he wounded so desperately in the thigh with his tusks that the poor man died the next day. To prevent similar accidents he was taken out of the menagerie, and so closely imprisoned that nobody could approach him. He died in about twelve months, and his skin is preserved in the Prince of Orange's cabinet. The other one, which is now in the same menagerie, is still very young, and his tusks exceed not two inches in length. When allowed to come out of the place where he is confined, he testifies his joy by leaping, bounding, and running, with much more agility than our hogs. On these occasions he carries his tail perfectly erect. The inhabitants of the Cape, on account of his swiftness, gave him the denomination of *hart looper*, or courser.

This animal unquestionably forms a genus distinct from all the other known races of hogs. Though he resembles them in the body, the want of cutting teeth and the singular structure of the head are characters too marked to be ascribed to the influence of climate, especially as there are hogs in Africa which differ from ours by being smaller only. Besides, it would appear that he cannot produce with our hogs. A Guinea sow was presented to him. After smelling her for some time he pursued her into a narrow place from which she could not escape, and tore her in pieces with his tusks. He afterwards abused a common sow to such a degree, that she was carried off in order to save her from destruction.

It is wonderful that this animal, which, as I formerly remarked, seems not be rare in its native country, has not been mentioned by any traveller, or at least in terms so vague, that no idea can be formed of it. Flacourt tells us, that in Madagascar there are wild boars which have two horns on the side of the nose, resembling two callosities; and that these animals are nearly as dangerous as the wild boars of France. M. de Buffon imagines, that this passage relates to the babiroussa, and perhaps he may be right: but it may, with equal probability, relate to our boar. These horns, which resembled two callosities, may have been the tusks of this boar, as well as those of the babiroussa, though extremely ill described; and what Flacourt adds, that these animals are dangerous, seems to correspond better with our African boar. M. Adanson, when speaking of a wild boar he saw in Africa, expresses himself in these terms: 'I saw,' says he, 'one of those enormous wild boars 'peculiar to Africa, and which, I believe, have never 'been mentioned by any naturalist. It was black, like 'the European wild boar, but vastly larger in size. It 'had four large tusks, the two superior of which 'bended in a semicircular form toward the front, and 'had the appearance of horns.' M. de Buffon supposes, that M. Adanson means to describe the babiroussa; and were it not for his authority I should have been led to believe, that M. Adanson intended to point out our African boar; for if he had the babiroussa under his inspection, I cannot comprehend how he should remark, that it had never been mentioned by any naturalist. He is too much conversant in Natural History, not to know that the babiroussa has been often described, and that its head is found in almost every musæum in Europe.

But in Africa there is perhaps snother species of wild boar, with which we are still unacquainted, and was the animal seen by M. Adanson. This conjecture is supported by the description which M. Daubenton has given of a part of the jaws of a Cape Verd wild boar. His remarks clearly prove, that it differs from our boars, and would apply directly to the one under consideration, if there had not been cutting teeth in each of these jaws.

I willingly assent to most of M. Allamand's reflections. But I persist in believing, as he himself at first believed, that the Cape Verd boar which I mentioned, and the jaws described by M. Daubenton, belong to the same species, though the former had no cutting teeth; for in no animal is the number and order of the teeth so various as in the hog kind. This difference alone seems not sufficient to constitute two species of the African wild boar and that of Cape Verd, especially as all the other characters of the head appear to be the same.

XIII.

THE MEXICAN WOLF.

Wolf with a very large head; great jaws; vast teeth; on the upper lips very strong bristles, reflected backwards, not unlike the softer spines of a porcupine; and of a gray and white colour; large erect cinereous ears; the space between marked with broad tawny spots: the head ash-coloured, striped transversely with bending dusky lines; neck fat and thick, covered with a loose skin, marked with a long tawny stroke: on the breast is another of the same kind; body ash-coloured, spotted with black; and the sides striped, from the back downwards, with the same colour; belly cinereous; tail long, of the colour of the belly, tinged in the middle with tawny; legs and feet striped with black and ash-colour: sometimes this variety is found white.

As the wolf is a native of cold climates he must have passed into America by the northern lands, being found equally in both continents. We have mentioned black and gray wolfs in North America. It appears that this species is diffused as far as New Spain and Mexico; and that in this warm climate it has undergone some alterations, without changing its nature or dispositions; for the Mexican wolf has the same figure, appetites, and habits, as the European or North American wolf; and all of them appear to be the same species. The Mexican wolf, or rather the wolf of New Spain, where he is more common than in Mexico, has five toes on the fore feet, and four on those behind. The ears are long and erect; and the eyes sparkle like those of our wolf. But the head is twice as large, the neck thicker, and the tail less bushy. Above the mouth there are some bristles as large, but not so stiff, as those of the hedgehog. Upon an ash-coloured ground, the body is marked with some yellow spots. The head is of the same colour with the body, and marked with transverse brownish lines, and the front is spotted with yellow. The ears are gray, like the head and body. There is a long yellow spot on the neck, another on the breast, and a third on the belly. On the flanks are transverse bands from the back to the belly. The tail is gray, with a yellow spot in the middle. The legs are barred with gray and brown. This is the most beautiful of all wolves, and its skin should be esteemed for its variety of colours. But nothing indicates it to be a different species from the common kind, which varies from gray to white, from white to black, and a mixture of both, without changing its species: and we learn from Fernandes, that these wolves of New Spain vary like the European wolf; for even in this country they are not all marked according to our description, some of them being of a uniform colour, and even totally white.

XIV.

THE ALCO.

We formerly remarked, that in Peru and Mexico, before the arrival of the Europeans, there were domestic animals called *alco*, which were nearly of the same size and dispositions with our small dogs; and that, from this conformity, and because they were equally faithful and attached to their masters, the Spaniards gave them the name of *Mexican* or *Peruvian dogs*. The species of these animals indeed seems not to differ essentially from that of the dog. Besides, the word *alco* might perhaps be a generic and not a specific term. Recchi has left us a figure of one of these alcos, which in the Mexican language was called *ytzcuinte porzotli*. It was prodigiously fat, and probably degraded by its domestic state, and by too much nourishment. The head is represented to be so small that it has no proportion to the size of the body. Its ears are pendulous, which is another mark of slavery. The muzzle resembles that of a dog; the fore part of the head is white, and the ears are pretty yellow. The neck is so short, that there is no interval between the head and shoulders. The back is arched, and covered with yellow hair. The tail is white, short, and pendulous, and descends no lower than the thighs. The belly is large, tense, and marked with black spots. It has six conspicuous paps. The legs and feet are white; and the toes, like those of the dog, are armed with long sharp claws. Fabri, who gives this description, concludes, after a long dissertation, that this animal is the same with the *alco*; and I believe his conclusion is well founded. But this appellation must not be regarded as exclusive; for there is another race of dogs in America to which it applies with equal propriety. Beside the dogs, Fernandes remarks, which the Spaniards transported from Europe to America, there are three other species, which are pretty similar to ours, both in their nature and dispositions; neither is their figure altogether different. The first and largest of these American dogs is called *xoloixtcuintli.* He is often three cubits long; and, what is remarkable, he is totally destitute of hair, and only covered with a soft close skin, marked with yellow and blue spots. The second is covered with hair, and of the size of our small Maltese dogs. He is marked with white, black, and yellow. His deformity, though singular, is not disagreeable: His back is arched; and his neck so short, that his head seems to proceed immediately from the shoulders. He is named in this country *michuacanens.* The third, which likewise resembles our small dogs, is called *techichi.* But he has a wild and melancholy aspect. The Americans eat his flesh.

From comparing the testimonies of Fabri and Fernandes, it is obvious, that the second dog, which this last author calls *michuacanens,* is the same with the *ytzcuinte porzotli,* and that this species of animal existed in America before the arrival of the Europeans; and the same must have been the case with the *techichi.* I am persuaded, therefore, that the word *alco* was a generic name, which applied equally to both, and perhaps to other races or varieties that we are unacquainted with. But, as to the first, Fernandes seems to have been deceived both with regard to the name and the animal. No author mentions naked dogs in New Spain. This race, commonly called *Turkish dogs,* come from India, and other warm climates of the Old Continent; and it is probable, that those seen in America by Fernandes had been transported thither, especially as he mentions his having seen this kind in Spain, before his departure for America. The proof is still farther corroborated by the circumstance of this animal's having no American name: Fernandes gives it the borrowed one of *xoloitzcuintli,* which is the name of the Mexican wolf. Thus, of these three species or varieties of American dogs, there remain only two, which are called indiscriminately *alco;* for, independent of the fat alco, which served as a lap-dog to the Peruvian ladies, there was a meagre and melancholy alco, which was employed in the chase; and it is by no means impossible, that the three races, apparently different from those of our dogs, spring from the same stock. The dogs of Lapland, Siberia, Iceland, &c. must have passed, like the foxes and wolves, from the one Continent to the other, and degenerated by the influence of the climate and a domestic state. The first *alco,* with the short neck, approaches the Iceland dog; and the *techichi* of New Spain is perhaps the same with the *koupara,* or *crab-dog* of Guiana, which in figure resembles the fox, and in hair the jackal. He has been called the *crab-dog,* because he chiefly lives upon crabs and other crustaceous animals. I have seen only one skin of this Guiana animal; and I am unable to determine whether it is a particular species, or whether it should be referred to those of the dog, fox, or jackal.

XV.

THE TAYRA, GALERA, OR GUINEA WEASEL.

Guinea weasel, with the upper jaw much longer than the lower; eyes placed mid-way between the ears and tip of the nose; ears like the human; tongue rough; tail declining downwards, lessening towards the point; feet strong, and formed for digging; shape of the body like that of the rat; size of a small rabbit; of a dusky colour; the hair rough.—*Pennant.*

This animal, of which Mr. Brown has given a figure and description, is of the size of a small rabbit, and has a considerable resemblance to the weasel or martin. He digs an habitation in the earth, and has great strength in his fore feet, which are much shorter than those behind. His muzzle is long, a little sharp, and garnished with whiskers. The under jaw is much shorter than the upper. He has six cutting and two canine teeth in each jaw, without reckoning the grinders. His tongue is rough, like that of the cat. His head is oblong, as well as the eyes, which last are placed at an equal distance between the ears and the point of the muzzle. His ears are flat, and resemble those of man. His feet are strong, and adapted for digging. The metatarsal bones are long; and he has five toes on all his feet. His tail is long, and tapers to a point. His body is oblong, and has a great resemblance to that of a large rat. He is covered with brown hairs, some of which are longer than others. This animal appears to be a small species of martin or polecat. Linnæus imagined, that the black weasel of Brasil might be the *galera* of Mr. Brown; and, indeed, the two descriptions afford some reason for the conjecture. Besides, this black weasel of Brasil is likewise found in Guiana, where it is called *tayra;* and I suspect that the word *galera* is a corruption derived from *tayra,* which is the true name of this animal.

XVI.

THE MERIAN OPOSSUM.

Merian opossum, with long, sharp pointed, naked ears; head, and upper part of the body, of a yellowish brown colour; the belly white tinged with yellow; the fore feet divided into five fingers; the hind into four and a thumb, each furnished with flat nails; tail very long, slender, and, except at the base, quite naked.

This animal is a native of the same climate, and belongs to a neighbouring species with the other opossums. Sibilla Merian is the first writer who has given a figure and a short account of it. Seba afterwards gave Merian's figure for the female, and added a new figure for the male, with a kind of description. This animal, says he, has very brilliant eyes, which are surrounded with a circle of deep brown hair. The body is covered with soft hair, or rather wool of a reddish yellow colour, but of a bright red on the back. The front, muzzle, belly, and feet, are whitish yellow. The ears are naked, and pretty hard. On the upper lip, and also above the eyes, there are long hairs in the form of whiskers. Its teeth, like those of the dormouse, are very sharp. Upon the tail of the male, which is naked, and of a pale red colour, there are dusky red spots, which appear not on the tail of the female. The feet resemble the hands of an ape; those before have the four toes, and the thumb garnished with short, blunt, nails; but on the hind feet the thumb alone has a flat, blunt nail, the other four toes being armed with small sharp claws. The young of these animals grunt nearly in the same manner as a pig. The paps of the female resemble those of the murine opossum. Seba properly remarks, that, in the figure given by Merian, the feet and toes are ill represented. The females produce five or six at a litter. The tail is very long, and prehensile, like that of the sapajous. The young mount upon the back of the mother, and adhere firmly with their tails twisted round hers. In this situation she carries them about with great nimbleness and security.

XVII.

THE AKOUCHI, OR OLIVE CAVY.

The akouchi is pretty common in Guiana and other parts of South America. It differs from the agouti by having a tail, which is wanting in the agouti. The akouchi is generally smaller than the agouti, and its hair is not red, but of an olive colour.

These are the only differences we know between the akouchi and agouti, which, however, seem to be sufficient to constitute two distinct species.

SUPPLEMENT.

In the original work we remarked, that the akouchi was a different species from the agouti; because the former had a tail, and the latter had no tail. The akouchi differs from the agouti still more in magnitude, being no larger than a young rabbit of six months old. The akouchi is found only in extensive woods. He feeds on the same fruits, and has nearly the same manners with the agouti. In the islands of Saint Lucia and Grenada he is called *agouti*. His flesh is white, and has the flavour of a young rabbit; and he is ranked amongst the finest game in South America. When the akouchis are pursued by dogs, rather than take the water, they allow themselves to be seized. M. de la Borde informs us, though I doubt the fact, that the females produce only one, or at most two young, at a litter. They are easily tamed, and have a small cry like that of the Guinea pig; but it is seldom heard.

We have given a figure of this animal, drawn from a well-preserved skin. Messrs. Aublet and Olivier assure me, that, in Cayenne, the hare is called *agouti*, and the rabbit *akouchi;* but that the agouti is the best food; and, speaking of the game of this country, they inform me, that the armadillos are still better food, except the nine-banded armadillo, which has a strong smell of musk; that, after the armadillos, the paca is the best game, because its flesh is wholesome and fat: the next in order are the agouti and akouchi. They likewise maintain, that the red couguar is used as food, and that its flesh has the taste of veal.

XVIII.

THE TUCAN, OR MEXICAN SHREW.

Mexican shrew with a sharp nose; small round ears; without sight; two long fore teeth above and below; thick, fat, fleshy body, short legs, so that the belly almost touches the ground; long crooked claws; tawny hair; short tail; length from nose to tail, nine inches.

Fernandes has given the name of *tucan* to a small quadruped of New Spain, whose size, figure, and natural habits, make it approach nearer to the mole than to any other species. It appears to be the same animal described by Seba under the denomination of the *red mole* of America; at least, the descriptions of the two authors correspond sufficiently to justify this conjecture. The tucan is perhaps somewhat larger than our mole. It is equally fat and fleshy, and its legs are so short that the belly touches the ground. The tail is short; the ears are small and round; and the eyes are so minute that they can scarcely be of any use to the animal. But it differs from the mole in the colour of the hair, which is reddish yellow, and in the number of toes, having only three before and four behind, while the mole has five toes on all the feet. It seems to differ from the mole in other articles: its flesh is good eating. It possesses not the instinct of discovering its retreat after having once left it, but, at every time, is obliged to dig a new hole; so that, in certain soils, which are agreeable to these animals, the holes are so numerous, and so near each other, that circumspection is necessary to walk there with safety.

XIX.

THE BRASILIAN SHREW.

Brasilian shrew, with a sharp nose and teeth; pendulous scrotum. It is of a dusky colour, marked along the back with three broad black strokes. The length from nose to tail five inches; that of the tail two.

We mention this animal under the denomination of the *Brasilian shrew;* because we are ignorant of its proper name, and it has a greater resemblance to the shrew than to any other animal. It is, however, considerably larger, being about five inches long from the extremity of the muzzle to the origin of the tail, which is not two inches, and consequently is proportionally shorter than that of the common shrew. It has a pointed muzzle, and very sharp teeth. Upon a brown ground colour three pretty large black bands extend longitudinally from the head to the tail, under which the scrotum appears hanging between the hind feet. This animal, says Marcgrave, sports with the cats, who discover no inclination to eat it. In the same manner the cats kill the European shrews, but never eat them.

XX.

THE ROCK CAVY.

Rock cavy, with divided upper lip; short ears; four toes on the fore feet, and three on the hind; colour of the upper part of the body like that of the common hare; belly white: the length one foot.

This animal, which is a native of Brasil, is neither a rabbit nor a rat, but seems to partake of both. It is about a foot long by seven inches in circumference. Its general colour is the same with that of our hares; and its belly is white: its upper lip is divided in the same manner, and it has the same large cutting teeth, and whiskers round the mouth and on the sides of the eyes. But its ears are rounded like those of the rat, and so short that they exceed not the height of a finger's breadth. The fore legs are not above three inches in length, and those behind are a little longer. The fore feet have four toes covered with a black skin, and armed with small short claws. The hind feet have only three toes, and the middle one is the longest. It has no tail. Its head is somewhat longer than that of the hare, and its flesh is like that of the rabbit, which it resembles in its manner of living. It likewise retires into holes: it does not, however, dig the earth, like the rabbit, but conceals itself in the clefts of rocks. Hence it is easily seized in its retreat. It is hunted as game, and its flesh is preferable to that of our best rabbits. The animal mentioned by Oviedo, and afterwards by Charlevoix and du Perrier de Montfraizier, under the denomination of *cori,* appears to be the same with the *aperea* or rock cavy. In some parts of the West Indies these animals may perhaps be reared in warrens, or in houses, like our rabbits; and this may be the reason why some of them are red, white, black, and variegated. This conjecture is not without foundation; for Garcilasso informs us, that in Peru there are wild and domestic rabbits which have no resemblance to those of Spain.

[The *cori* is a small quadruped, somewhat resembling our rabbits and moles. It has small ears, which it carries so flatly reclined backward, that it is difficult to perceive them. It has no tail. Some of them are white, others black, and others spotted with black and white. Some of them are totally red, and others spotted with red and white. They are tamed, and never defile the houses. They eat herbage, and are easily maintained. Their flesh has the taste and flavour of the best rabbits.—*Montfraizier.*]

XXI.

THE TAPETI, OR BRASILIAN HARE.

Brasilian hare with very long ears; a white ring round the neck; face of a reddish colour; chin white; black eyes; colour of the body like the common hare, only darker; belly whitish; no tail; some want the white ring round the neck.

The tapeti seems to make a near approach to the species of the hare or rabbit. It is found in Brasil and many other parts of America. In figure it resembles the European rabbit; and it resembles the hare in size and colour, only it is a little browner. Its ears are very long, and shaped like those of the hare. Its hair is red on the forehead, and whitish on the throat. Some of them have a white circle round the neck; but others have a white throat, breast, and belly. They have black eyes, and whiskers like our rabbits; but they want the tail. The tapeti resembles the hare in its manner of living, in fecundity, and in the quality of its flesh, which is extremely good. Like the hare, it dwells in the fields or in the woods, and burrows not, like the rabbit. The animal of New Spain, mentioned by Fernandes under the name of *citli,* appears to be the same with the *tapeti* of Brasil; and both are perhaps only varieties of the European hares, who have passed by the northern lands from the one Continent to the other.

Some other species of animals might be added to the preceding list; but the accounts given of them are so vague, that I choose rather to confine myself to what is known with some degree of certainty, than to give way to conjecture, or to exhibit creatures of imagination as real species. But notwithstanding this limitation, intelligent men will easily perceive, that my history of quadrupeds is as complete as they could possibly expect. It comprehends a great number of new animals, and none of those who were formerly known are omitted.

The preceding notices, though composed of twenty-one articles, contain not above nine or ten distinct species; for all the others are only varieties. The white bear is only a variety of the common kind; the Tartarian cow, of the bison; the Guinea and Cape Verd hogs, of the common hog, &c. Hence, by adding these ten species to about one hundred and eighty, whose history we have given, the total number of quadrupeds, the existence of which is properly ascertained, exceeds not two hundred species upon the surface of the whole known world.

XXII.

THE CRAB-EATER.

Cayenne opossum, with a long slender face; ears erect, pointed, and short; the coat woolly, mixed with very coarse hairs, three inches long, of a dirty white from the roots to the middle; from thence to the ends of a deep brown; sides and belly of a pale yellow; legs of a dusky brown; thumb on each foot distinct; on the toes of the fore feet, and thumb on the hind, are nails; on the toes of the hind feet crooked claws; tail very long, taper, naked, and scaly. Length seventeen inches; that of the tail fifteen and a half. The subject measured was very young.

The name *crab-eater*, or *crab-dog*, has been given to this animal, because crabs are his principal food. He has very little relation to the dog or fox, to which some travellers have compared him. He seems to be more nearly allied to the opossums; but he is much larger, and the female crab-eater carries not her young, like the female opossum, in a pouch under her belly. Hence the crab-eater appears to be a detached species, and different from all those we have formerly described.

In the figure, the long, naked, scaly tail, the large thumbs without claws on the hind-feet, and the flat claws on the fore feet, are remarkable. This animal, whose skin is preserved in the royal cabinet, was young when it was transmitted to us. It is a male; and the following is a description of it.

The length of the whole body, from the nose to the origin of the tail, is about seventeen inches. Before it is six inches three lines high, and six inches and a half behind. The tail, which is grayish, scaly, and naked, is fifteen inches and a half long, ten lines in circumference at the origin, and gradually tapers to a point.

As the legs of this animal are very short, he has at a distance some resemblance to a terrier. The head is not very different from that of a dog, and exceeds not four inches one line in length, from the point of the nose to the occiput. The eye is not large; the edges of the eye-brows are black; and above the eye there are hairs of an inch and a quarter in length. There are similar hairs on the side of the cheek near the ear. The whiskers are black, and about an inch and a half long. The opening of the mouth is near two inches. The upper jaw is armed on each side with a crooked canine tooth, which reaches beyond the under jaw. The ear is brown, naked, broad, and round at the extremity.

The hair on the body is woolly, and interspersed with other long stiff black hairs. These long hairs increase upon the thighs and the spine of the back, which is totally covered with them, and form a kind of mane from the middle of the back to the origin of the tail: they are three inches long, of a dirty white colour from the base to the middle, and afterwards of a dark brown as far as the point. The hair on the sides, as well as on the belly, is yellowish white; but it approaches more to yellow toward the shoulders, and on the thighs, neck, breast, and head, where this yellow tincture is mixed in some places with brown. The sides of the neck are yellow; and the legs and feet are of a blackish brown colour. There are five toes on each foot. The fore foot is an inch and three quarters long, the largest toe nine lines, and the furrowed claw two lines. The toes are a little bended, like those of the rat, the thumb alone being straight. The hind feet are an inch and eight lines long, the largest toe nine lines, and the thumb half an inch. The thumb is thick, broad, and at a distance from the toes, as in the apes. The nail of the thumb is flat; but those of the other toes are crooked, and reach beyond their points. The thumb of the fore foot is straight, and not removed from the other toe.

M. de la Borde informs me, that this animal is very common in Cayenne, and that it always frequents the savannahs and other marshy places.

'It climbs trees,' he remarks, 'with great dexterity, 'and continues oftener upon them than on the ground, 'especially during the day. It has fine teeth, and defends itself against the dogs. Crabs are its principal 'nourishment, and it is always fat. When unable to 'draw the crabs from their holes with its foot it introduces the tail which it uses as a hook. The crab 'sometimes lays hold of the tail, and makes the animal 'cry. This cry has some resemblance to that of a man, 'and is heard at a great distance. But its ordinary voice 'is a kind of grunting, like a pig. The female produces 'four or five young at a litter, and deposits them in the 'hollows of old trees. The natives of the country eat 'its flesh, which resembles that of a hare. These animals are easily tamed, and they are fed in the houses, 'like dogs and cats, with all kinds of victuals. Hence 'their taste for crabs is by no means exclusive.'

It is alledged, that there are two species of crab-eaters in Cayenne. The first is the animal we have already described: the other is not only a different species, but belongs to a different genus. Its tail is totally covered with hair, and it seizes crabs with its paws only. These two animals resemble each other in the head alone; and they differ in the figure and proportions of the body, as well as in the structure of the feet and claws.

XXII.

ANONYMOUS ANIMAL.

We here give the figure of an undescribed animal, the drawing of which was made by the Chevalier Bruce, who permitted me to copy it. The animal, which we shall call *anonymous*, till we learn its real name, has some similarities to the hare, and others to the squirrel. Mr. Bruce gave the following account of it in writing.

'In Lybia, on the south side of the lake formerly 'called *Palus Tritonides*, there is a very singular animal, 'from nine to ten inches long, with ears nearly as long 'as the half of the body, and proportionally broad, a 'circumstance which takes place in no other quadruped 'except the long-eared bat. Its muzzle resembles that 'of the fox; and yet it seems to approach nearer to 'that of the squirrel. It lives on the palm-trees, of 'which it eats the fruit. It has short retractile claws, 'and is a very beautiful creature. Its colour is white, 'mixed with a little gray and a bright yellow. The 'inside of the ears is naked in the middle only. They 'are covered with brown hair mingled with yellow, and 'garnished within with large white hairs. The end of 'the nose is black, the tail yellow, and black at the 'point. The tail is pretty long, but of a different form 'from that of the squirrel; and all the hair, both on the 'body and tail, is very soft.'

XXIII.

MADAGASCAR RAT.

In the figure is represented a small animal from Madagascar, which was drawn alive, when in the possession of the Countess of Marsan. It appeared to make a nearer approach to the species of the palm-squirrel than to that of the rat; for I was assured that it frequented the palm-trees. I have not been able to procure farther information concerning this animal. It may be remarked, however, that as its claws did not project, it seemed to constitute a species very different from that of the rat, and to approach nearer to the palm-squirrel. To this animal may be referred the rat on the south-west coast of Madagascar, mentioned by the Dutch voyagers; for they tell us, that these rats live in the palm-trees, and eat the dates; that their body is long, their muzzle sharp, their legs short, and their tail long and spotted. These characters correspond so well with those represented in the figure of our Madagascar rat, as to induce us to believe that the animal formerly mentioned belongs to this species.

It lived several years with the Countess of Marsan. Its movements were extremely brisk, and its cry was nearly similar to that of the squirrel, though much weaker. Like the squirrels it carried its food to its mouth with the fore paws, erected its tail, and leaped about. It bit desperately, and could not be tamed. It was fed with almonds and fruits. It never came out of its cage, except in the night; and it endured the winters very well in an apartment where there was a small fire.

ADDITIONS AND CORRECTIONS.

Additions *to the Article concerning the Formation of the Planets,* Vol. I. p. 19.

I.

On the Distance of the Earth from the Sun.

In p. 19, I said, that the earth is situated thirty millions of leagues from the sun. This was the general opinion of astronomers in the year 1745, when I composed the treatise on the formation of the planets. But later observations, and particularly those derived from the transit of Venus over the Sun's disc in 1769, show that this distance of thirty millions should be augmented three or four millions of leagues. It is for this reason, that in the *Epoques de la Nature* I have always reckoned the mean distance of the sun from the earth to be thirty-three million of leagues, instead of thirty. This remark was necessary to prevent the suspicion of my having contradicted myself.

I must farther remark, that the sun is not only thirty-three or thirty-four millions of leagues distant from the Earth, but from the same observations it has likewise been discovered that the volume of the Sun is a tenth part larger than was formerly supposed; and, consequently, that the whole mass of the planets is only an eight hundredth part of that of the sun, and not a six hundred and fiftieth part, as I had advanced from the information we possessed in the year 1745. This difference strengthens the probability that the matter of the planets was projected from the body of the sun.

II.

Of the Matter of the Sun and Planets.

I had remarked, in p. 20, 'that the opaque bodies of the 'planets were detached from the luminous matter of which 'the sun is composed.' These expressions are not correct; for the matter of the planets, when projected from the sun, was equally luminous as that of the sun itself, and the planets became not opaque till their state of fluid brightness had ceased: the duration of this state in several kinds of matter I determined by experiment; and from analogy, I calculated the continuation of this bright state in each of the planets. Besides, as the torrent of matter, projected from the body of the sun by the comet, traversed the immense atmosphere of that luminary, it carried off the volatile, aqueous, and aerial parts of which the seas and atmospheres of the different planets are now composed. Hence we may conclude, that the matter of the planets is the same, in every respect, with that of the sun, and that there is no other difference but in the degree of heat, which is extreme in the sun, and greater or smaller in the planets, according to the compound ratio of their thickness and density.

III.

Of the relation between the Density of the Planets and their Celerity.

In p. 23 I said, that *according to this relation between the celerity and density of the planets, the density of the earth ought not to exceed* 206$\frac{7}{18}$, *instead of* 400, *which is its real density.* The density here ascribed to the earth is too great with relation to the quickness of its motion round the sun, and ought to be a little diminished for a reason which had formerly escaped me. The moon, which in this computation should be regarded as forming a part of the earth, is less dense in the ratio of 702 to 1000, and the lunar globe is $\frac{1}{49}$th of the bulk of the terrestrial. Hence, if the moon were as large as the earth, we should diminish the density of the latter 400 in the ratio of 1000 to 702, which produces 281, *i. e.* 119 of diminution in the density 400. But as the moon is only $\frac{1}{49}$th part of the bulk of the earth, it will produce only $\frac{119}{49}$, or 2$\frac{3}{7}$ths of diminution. Consequently the density of our globe, with relation to its celerity, instead of 206$\frac{7}{18}$, ought to be estimated at 206$\frac{7}{18}$+2$\frac{7}{3}$, *i. e.* nearly 209. Besides, we may suppose that our globe at the beginning was less dense than it is at present, and that it is become much more compact both by cooling, and by the sinking of vast caverns, with which its interior parts abounded. This opinion accords with those revolutions which happened, and still continue to happen, both on the surface of the earth and even at considerable depths. By the aid of this fact we are enabled to explain the possibility that the waters of the sea were formerly 2,000 fathoms above those parts of the globe which are now inhabited; for these waters would still cover the whole surface of the earth, if by immense depressions different parts had not sunk, and formed those receptacles for the waters which at present exist.

If we suppose the diameter of the globe to be 2,863 leagues, it would be two leagues more when covered with 2,000 fathoms of water. This difference in the bulk of the earth, produced by the sinking of the waters, gives an augmentation of a $\frac{1}{477}$th part of its density. This augmentation of the density, or diminution of the bulk of the globe, may be doubled, and perhaps tripled, by the sinking and overturning of mountains, and the consequent filling up of valleys; so that since the waters fell upon the earth, its density may be supposed to have increased one-hundredth part.

IV.

On the relation asssigned by Newton between the Density of the Planets and the degrees of Heat to which they are exposed.

In p. 23, I remarked, 'that notwithstanding the regard 'due to the conjectures of Newton, I cannot help thinking that the densities of the planets have a nearer relation to their celerities than to the degrees of heat to 'which they are exposed.' From calculating the action of the solar heat upon the planets, it appears that this heat in general is inconsiderable, and that it has never produced any great change in the density of each planet; for the action of the solar heat, which is weak in itself, has no influence on the density of the matter of which the planets are composed, except at their surfaces. It cannot act on the internal parts, because it penetrates to a very small depth only. Hence the total density of a planet has no relation to the heat transmitted to it by the sun.

It appears to be certain, therefore, that the density of the planets has no dependence on the solar heat, but on the contrary, that their densities have a necessary relation with their celerities, which last increase or diminish in proportion to their distances from the sun. We have seen, that at the general projection, the more dense parts were not removed so far from the Sun as the less dense. Mercury, which is composed of the most dense matter projected from the sun, remained in the neighbourhood of that luminary; while Saturn, which consists of the lightest matter, is removed to a great distance from the Sun: and as the most distant planets revolve round the Sun with greater celerity than those that are nearer, it follows, that their density has a direct relation with their celerity, and still more with their distance from the sun. The distances of the six planets from the sun are as 4, 7, 10, 15, 52, 95; and their densities as 2040, 1270, 1000, 730, 292, 184. And if we suppose the densities to be in the inverse ratio of the distances, they will be as 2040, 1160, 889$\frac{1}{2}$, 660, 210, 159. This last relation between their respective densities is perhaps more just than the former; because it seems to be founded on the physical cause which must have produced the difference of density in each planet.

ADDITIONS *to the Article concerning Geography*, Vol. I. p. 37.

I.

On the Extent of Terrestrial Continents.

PAGE 37 I said, that ‘ the longest line which can be ‘ drawn in the ancient Continent is about 3,600 leagues.’ By leagues I mean those used in the environs of Paris, which are 2,000 or 2,100 fathoms long, and about 27 of them make a degree.

Besides, though in this article of general geography I endeavoured to reach that degree of exactness which subjects of that nature require, yet a few slight errors have escaped me. For example, 1. I have not used the names adopted or given by the French to several parts of America. I uniformly followed the British globes made by Senex, of two feet diameter, from which my charts were exactly copied. The British are more just than the French with regard to countries they discover, or through which they travel. They preserve the original name of each country, or that which was bestowed on it by the first discoverers. We, on the contrary, often give French names to the countries we visit, which is the cause of that obscurity in the geographical nomenclature of our language. But as the lines which traverse the two continents in their greatest length are well marked in my charts by the two extreme points, and several other intermediate ones, whose names are generally adopted, no essential ambiguity can arise from this circumstance.

2. I likewise neglected to give the calculation of the surface of the two continents, because it is easily made on a large globe. But as many persons have expressed a desire to see this calculation, I here subjoin that which M. Robert de Vaugondi transmitted to me at the time.* From this calculation it appears, that on the left of the line of partition there are 2,471,092¾ of square leagues, and 2,469,687 square leagues on the right of the same line; and consequently that the Old Continent consists of about 4,940,780 square leagues, which is not one fifth part of the earth's surface.

In the same manner, the part on the left of the line of partition in the New Continent, contains 1,069,286⅚ square leagues, and that on the right of the same line consists of 1,370,926$\frac{1}{12}$; in all about 2,140,213 square leagues; which makes not one half of the surface of the Old Continent. As both Continents contain but 7,080,993 square leagues, their superficies is not near one third of the total surface of the globe, which is about 26 millions of square leagues.

3. I ought to have mentioned the small difference of inclination that subsists between the two lines by which I divided the two Continents. I contented myself with saying, that they were both inclined to the Equator, in

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* Calculation of our Continent by geometrical leagues square.

14d.	14d.	14d.	14d.	14d.	
5 E	8 D	10½ C	12½ B	13½ A	14d
78,750	80,937	100,625	113,750	120,312½	

Calculation of the left half.		Calculation of the right half.	
A × 3 =	360,937½	A × 3 =	360,937½
A × 3¾ =	421,093¾	A × 1 =	120,312½
B × 3½ =	398,125	B × 1 =	113,750
B × 4 =	455,000	B × 4⅓ =	492,916⅔
C × 2 =	201,250	C × 1 =	100,625
C × 3 =	301,875	C × 4⅓ =	436,041⅓
D × 1 =	80,937½	D × 1 =	80,937½
D × 2 =	161,874	D × 4⅓ =	350,729
E × 1 =	78,750	E × 1 =	78,750
E × ″⅐ =	11,250	E × 4¼ =	334,687½
	2,471,092¾		2,469,687

2,471,092¾
2,469,687

Difference . . 1,405¾

Which is scarcely a degree and a half square.

Calculation of the Continent of America according to the same measures.

Calculation of the left half.		Calculation of the right half.	
D × 2 =	161,965	D × 2⅔ =	215,833⅓
C × 2 =	201,250	C × 2¼ =	225,406¼
B × 2 =	227,500	A × ″⅕ =	24,062½
A × ″½ =	60,156¼	A × 1⅕ =	144,375
A × ″⅓ =	80,208⅓	B × 2 =	227,500
B × ″⅘ =	91,000	C × 2⅙ =	218,020
C × 1¼ =	125,801¼	D × ″⅕ =	15,750
D × 2 =	121,406		
	1,069,286⅚		1,070,926$\frac{1}{12}$

1,070,926$\frac{1}{12}$
1,069,286⅚

Difference . . 1,639¼

Which is scarcely a degree and one fifth square.

Superficies of the New Continent. .	2,140,213
Superficies of the Old Continent . .	4,940,780
Total . . .	7,080,993 sq. leagues.

opposite sides, about 30 degrees, which is not the precise fact; for that of the Old Continent is a little more than 30 degrees, and that of the New a little less. If I had given this explanation, I should have avoided the imputation of having drawn two lines of unequal lengths, under the same angle between two parallels; which would have proved, as an anonymous critic remarks, that I am unacquainted with the elements of geometry.

4. I neglected to distinguish Upper from Lower Egypt; there is the appearance of a contradiction. In the first of these passages, Egypt seems to be ranked among the most ancient lands, while, in the second, it is reckoned among the most recent. I was wrong in not distinguishing, as I had elsewhere done, Upper Egypt, which is a very ancient land, from Lower Egypt, which is a very new territory.

II.

Of the Form of Continents.

With regard to the figure of Continents, I shall transcribe a passage from the ingenious author of the Philosophical and Political History of the two Indies.

'It is now thought to be certain,' he remarks, 'that 'the surface of the New Continent is not one half of 'that of the Old. Besides, in their figure there are 'some striking analogies.—They seem to form two im'mense bands of earth, which arise from the Arctic pole, 'terminate in the South, and separated on the East and 'West by the ocean that invests them. Independent 'of the structure of these two bands, and of the counter'poise or symmetry which takes place in their figure; 'it is apparent, that their equilibrium depends not on 'their position; it is the fluctuation of the sea which 'produces the stability of the earth. To fix the globe 'on its base, it was necessary to have an element which, 'by floating continually around this planet, should 'counterbalance, by its weight, the other substances, 'and restore that equilibrium which the collision of the 'other elements might have disturbed. Water, by its 'fluidity and gravity, is well fitted to support that har'mony and that balance of the different parts of the 'globe around its centre.

'If the waters which still moisten the bowels of the 'New Hemisphere had not deluged its surface, man 'would soon have cut down the woods, drained the 'marshes, and given consistence to a watery soil.—He 'would have opened vents to the winds, and confined 'the rivers within their banks; the climate, of course, 'would have already been changed. But an unculti'vated and thinly inhabited hemisphere announces a 'recent land, while the waters which environ its coasts 'still creep silently through its veins.'

On this subject I shall remark, that, although there is more water on the surface of America than on that of other countries, we ought not to conclude from this circumstance, that an internal sea is contained in the bowels of this new land. We should only infer from this number of lakes, marshes, and large rivers, that America has been peopled long after Asia, Africa, and Europe, where the quantity of stagnant waters is much less. Besides, a thousand other circumstances concur in showing, that the Continent of America in general ought to be regarded as new land, in which Nature has not had time to acquire all her powers, nor to exhibit them by a numerous population.

III.

Of the Terra Australis, p. 38.

To what I have said concerning the Terra Australis, I shall add, that, within these few years, new attempts have been made to discover it, and that some points of it have been found after departing either from the Cape of Good Hope, or from the Isle of France; but that these new voyagers have uniformly met with thick fogs, snow, and ice, in the 46th or 47th degree of South latitude. After conversing with some of these voyagers, and collecting all the information I could derive from other sources, I perceived that they all agreed with regard to this fact, and that they found ice in much lower latitudes than is to be met with in the northern hemisphere. They likewise uniformly met with fogs in the same latitudes where they found ice, though it was summer in these climates at the time the experiments were made. It is therefore extremely probable, that, below the 50th degree, it will be in vain to search for temperate countries in the southern hemisphere, where the freezing cold is much farther extended than in the northern. The thick fog is produced by the presence or neighbourhood of the ice. This fog consists of minute particles of snow, which are suspended in the air, and render it obscure: it often accompanies the great floating masses of ice, and reigns perpetually in frozen regions.

Besides, the British have lately sailed round New Holland as well as New Zealand. These southern countries are more extensive than the whole of Europe. New Zealand is divided into several islands; but New Holland ought rather to be regarded as a part of Asia, than as an island belonging to the Southern Continent; for New Holland is only separated from the land of the Papous, or New Guinea, by a narrow strait, and the whole Archipelago, which extends southward from the Philippine isles, as far as the country of Arnheim in New Holland, and toward the west and south, as far as Sumatra and Java, appears to belong as much to the continent of New Holland, as to the southern parts of Asia.

Captain Cook, who ought to be regarded as the greatest navigator of this age, and to whom we are indebted for an infinite number of new discoveries, has not only given a chart of the coasts of Zealand and New Holland, but has likewise explored an immense tract of the south sea in the neighbourhood of America. He departed from the south point of America on the 30th of January 1769, and he traversed a great part of the ocean under the 60th degree, without discovering any land. From Captain Cook's chart we may perceive the great extent of sea which he explored; and his tract demonstrates, that, if any lands exist in this part of the globe, they must be far removed from the Continent of America; for New Zealand, which is situated between the 35th and 45th degrees, is very distant from America. But it is still to be hoped, that other navigators, following the track of Captain Cook, will traverse the southern ocean under the 50th degree, and that they will discover whether these immense regions, which extend more than two thousand leagues, consist of land or of sea. However, I do not imagine that the southern regions, beyond the 50th degree, are so temperate that any advantage could be derived to us from the discovery of them.

IV.

Concerning the Invention of the Mariner's Compass, p. 42.

With regard to the invention of the mariner's compass, I have to add, that, from the testimony of Chinese authors, of which M. le Rouse and M. de Guignes have made an abridgment, it appears to be certain, that the polarity of the magnetic needle has been very anciently known to the inhabitants of China. The figure of these first compasses was those of a man, who turned upon a pivot, and whose right arm pointed to the south. The time of this invention, according to certain Chinese chronicles, was 1115 years before the Christian æra, and, according to others, 2700. But, notwithstanding the antiquity of this discovery, it does not appear that the Chinese had ever derived from it the advantage of making long voyages.

Homer, in the Odyssey, tells us, that the Greeks employed the loadstone to direct their navigation when they went to besiege Troy; and this æra is nearly the same with that recorded in the Chinese chronicle. Hence we can no longer doubt, that the direction of the loadstone toward the pole, and even the use of the mariner's compass in navigation, were known to the ancients at least three thousand years ago.

V.

Of the Discovery of America, p. 42.

To what I said, p. 42, concerning the discovery of America, a critic of more judgment than the author of *Lettres a un Americain*, has accused me of doing a kind of injury to the memory of so great a man as Christopher Columbus. 'It is confounding,' he remarks, 'Columbus 'with his sailors, to think that he could believe the sea 'rose toward the sky, and that they perhaps touched 'each other on the southern part of the globe.' This criticism is extremely just. I ought to have softened this fact, which I had extracted from some historical relation; for this great navigator, it is to be presumed, must have had very distinct notions concerning the figure of the earth, which he derived both from his own voyages, and from those of the Portuguese to the Cape of Good Hope and the East Indies. It is well known, however, that Columbus, when he arrived at the New Continent, thought himself at no great distance from the east coasts of Asia. As no man, at that period, had circumnavigated the world, he could not know its circumference, and did not imagine that the earth was so extensive as it has been demonstrated by later discoveries. Besides, it must be acknowledged, that this first navigator toward the west, could not fail to be astonished to find, that, when below the Antilles, it was impossible for him to gain the southern regions, and that he was continually forced back. This obstacle still subsists. We cannot in any season, sail directly from the Antilles to Guiana; because the currents are extremely rapid, and constantly run from Guiana to those islands. Ships sail from Guiana to the Antilles in five or six days; but they require two months to return. In order to return, they are obliged to make a large circuit toward the Old Continent, from whence they direct their course toward the Terra Firma of South America. These rapid and perpetual currents from Guiana to the Antilles are so violent that they cannot be surmounted by the aid of the wind; and, as this circumstance is unexampled in the Atlantic ocean, it is not surprising that Columbus, who notwithstanding all the resources of his genius and knowledge in the art of navigation, could not advance toward the southern regions, should think that something of a very extraordinary nature existed in this place, and perhaps that there was a greater elevation in this part of the sea than in any other; for the currents from Guiana to the Antilles actually run with as much rapidity as if they descended from a height.

The motion of the following rivers may give rise to the currents from Cayenne to the Antilles.

1. The impetuous river of the Amazons, whose mouth is seventy leagues broad, and its direction more to the north than the south.
2. The river Ouassa is likewise rapid, has the same direction, and its mouth is nearly a league wide.
3. The Oyapok is still more rapid than the Ouassa, passes through a greater tract of land, and its mouth is nearly of the same dimensions.
4. The Aprouak has nearly the same extent of course and of mouth as the Ouassa.

5. The river Kaw is less extensive both in its course and mouth; but though it issues from a savannah about twenty-five or thirty leagues from the sea, it is extremely rapid.

6. The Oyak, which is a considerable river, divides into two branches at its mouth, and forms the island of Cayenne. This river, at the distance of twenty or twenty-five leagues, receives another, called Oraput; it is very impetuous, and derives its source from a mountain of rocks, from whence it descends in rapid torrents.

7. One branch of the Oyak runs, near its mouth, into the river of Cayenne; and these two rivers when united are more than a league broad; the other branch exceeds not half a league.

8. The river of Kourou, which is very rapid, and not above half a league wide at the mouth, without reckoning the Macousia, which, though it furnishes much water, comes from no great distance.

9. The Sinamari is an impetuous river; it comes from a great distance, and its bed is pretty narrow.

10. The river Maroni, though it be very rapid, comes from a great distance. Its mouth is more than a league broad, and next to the Amazon it discharges the greatest quantity of water. It gives rise to no islands; while the mouths of the Amazon and Oronoko are interspersed with a great number.

11. The rivers of Surinam, of Barbiché, of Essequebé, and some others, till we reach the Oronoko, which is a very large river.

By the accumulations of mud and of earth brought down from the mountains by these rivers, it should appear, all the valleys of this vast continent have been formed; in the middle of the continent there are some mountains, most of which have formerly been volcanoes, and are not sufficiently elevated to allow their summits to be covered with snow or ice.

Hence it is apparent, that the united force of all these rivers gives rise to that general current of the sea from Cayenne, or rather from the Amazon to the Antilles; and that this general current extends perhaps above sixty leagues from the eastern coast of Guiana.

ADDITIONS *to the Article, Of the Production of Strata,* Vol. I. p. 43.

I.

Concerning the Strata in different parts of the Earth.

WE have some examples of quarries and pits of considerable depths, of which the different strata have been examined and described; such as the pit of Amsterdam, which descends 232 feet, and that of Marly-la-Ville, which is 100 feet deep. Many other examples might be given, if observers had agreed in their denominations. But some give the name of *marl* to white clay; others apply the term *flint* to round calcareous stones; and others give the denomination of *sand* to calcareous gravel. Hence little advantage can be derived either from their researches or their long dissertations on these subjects; because we are under a perpetual uncertainty with regard to the nature of the substances they describe. We shall, therefore, confine ourselves to the following examples:

An excellent observer has written to one of my friends, in the following terms, concerning the strata in the neighbourhood of Toulon: 'To the north of the city of 'Toulon,' he remarks, 'there is an immense quantity 'of stony matter, which occupies the declivity of the 'chain of mountains, and stretches through the valley 'from east to west; and one part of it forms the soil of 'the valley, and loses itself in the sea. This stony 'matter is commonly called *saffrè;* but it is that species 'of tufa which is denominated *marga toffacea fistulosa* 'by naturalists. M. Guettard desired me to furnish him 'with all the information I could obtain concerning this 'saffre, as well as specimens of the matter itself, that he 'might examine it, and give a detail of its qualities in 'his memoirs. I sent them both; and I believe I have 'satisfied him; for he has thanked me for the information I communicated. He tells me, that he is to 'return to Provence and Toulon in the beginning of 'May. M. Guettard, however, will probably give us 'nothing new on this subject; for M. de Buffon has 'exhausted it in the first volume of his Natural History, under the article, *Proofs of the Theory of the 'Earth;* and it appears, that in composing this article 'he had in his eye the mountains of Toulon and their 'ridge.

'At the commencement of this ridge, which consists 'of a more or less hard tufa, we find in small cavities of 'the nucleus of the mountain, quantities of very fine 'sand, which are probably the balls mentioned by M. 'de Buffon. After breaking other superficial parts of 'the nucleus, we find numbers of sea-shells incorporated 'with the stone. I have several of these shells, the 'enamel of which is well preserved. I will send them 'soon to M. de Buffon.'

M. Guettard, who has made more observations of this kind than any other naturalist, expresses himself in the following terms when he treats of the mountains in the neighbourhood of Paris.

‘ Below the vegetable soil, which exceeds not two or three feet, is placed a bed of sand from four or six to twenty, and often thirty feet thick. This bed is commonly replete with stones of the nature of grind-stone. In some districts we meet with detached masses of free-stone in this sand bed.

‘ Below this sand we find a tufa, from ten or twelve to thirty, forty, and even fifty feet thick. This tufa is not commonly of one equal thickness. It is frequently cut by different strata of spurious or clayey marl, of the *cos* which the workmen call *tripoli*, or of good marl, and even by small beds of pretty hard stones. Under this bed of tufa are found those which furnish stones for building. These beds vary in thickness: at first they exceed not one foot. In some districts three or four of them lie above each other. They are succeeded by one of about ten feet, both the surface and interior parts of which are interspersed with moulds or impressions of shells. It is followed by another about four feet, which rests upon one from seven to eight, or rather upon two of three or four feet. After these beds there are several others, which together form a mass of at least three fathoms. This mass, after piercing a bed of sand, is succeeded by clays.

‘ This bed of sand is earthy and reddish, and is from two and a half to three feet thick. After this comes a bed of spurious clay of a bluish colour; it is a clayey earth mixed with sand; the thickness of this bed is about two feet, and is followed by another of five, which consists of a smooth black clay, the broken portions of which are nearly as brilliant as jet. Lastly, this black clay is succeeded by a blue, which forms a stratum from five to six feet thick. In these different clays we find pyrites of a pale yellow colour, and of various figures. The water found below all these clays prevented us from penetrating any deeper.’

The strata in the quarries of the district of Moxouris, above the suburb of Saint-Marceau, are disposed in the following order.

	Feet.	Inches.
‘ 1. Vegetable soil - - - - -	1	
‘ 2. Tufa - - - - - -	12	
‘ 3. Sand - - - - - - - -	18	
‘ 4. Yellowish earth - - - -	12	
‘ 5. Tripoli; that is, a white, fat, compact earth, which hardens when exposed to the sun, and marks any substance in the same manner as chalk	30	
‘ 6. Flints, or a mixture of greasy sand	12	
‘ 7. Rock - - - - - -	2	
‘ 8. A stratum of small stones, from one to two feet - - - -	2	
‘ 9. Two strata of stone, which dissolves by the operation of the air and weather - - - - - -	1	
‘ 10. Earth and gravel - - -	1	6
‘ 11. Free-stone - - - - -	1	6
‘ 12. Very hard lime-stone - - - -	1	
‘ 13. A greenish stratum - - - -	1	6
‘ 14. A tender calcareous stone, which forms two strata, one of 18 inches, and the other of two feet - -	3	6
‘ 15. Several small beds of bastard calcareous stone. They precede the sheet of water common in pits. This sheet the diggers are obliged to remove before they can obtain the potters’ clay, which lies between two waters. In all -	99	

I have given this specimen for want of a better; for the uncertainties with regard to the nature of the different strata are apparent. We cannot therefore be too anxious in recommending to observers to be more exact in defining the nature of those materials they attempt to describe. They may at least distinguish them into vitrescent and calcareous, as in the following example:

The soil of Lorrain is divided into two great zones: the eastern, which covers the chain of *Voges*, which are primitive mountains, composed entirely of vitrifiable and crystalized matters, as granite, porphyry, jasper, and quartz, disposed in detached blocks or groups, and not in regular strata or beds. In all this chain of mountains there is not the smallest vestige of any marine production; and the hills which proceed from them consist of vitrifiable sand. Where they terminate, and upon a continued bounding line of their descent, the other zone commences, which is totally calcareous, disposed in horizontal beds, and replete, or rather completely formed, of sea bodies.

The banks and beds of the earth in Peru are perfectly horizontal, and correspond sometimes at a great distance in different mountains, most of which are two or three hundred fathoms high. They are in general inaccessible, and often as perpendicular as walls, which gives us an opportunity of perceiving the extremities of their horizontal strata. When any of them happens to be round and detached from others, each bed appears like a very flat cylinder, or a section of a cone of no great height. These different beds, placed one above another, and distinguished by their colour and various contours, often resemble a regular and artificial structure. In this country we see the mountains perpetually assuming the appearance of ancient and sumptuous palaces, of chapels, of castles, and of domes. They are sometimes fortifications composed of long curtains, and defended with bulwarks. After examining these objects, and the correspondence of their strata, we can hardly entertain a doubt, that the circumjacent land has not at some period been really sunk. It appears, that those mountains, whose bases were most solidly supported, remained as monuments to indicate the height which the soil of these countries anciently possessed.

The mountain of Birds, called in the Arabic *Gebeliter*, is so equal from top to bottom, for the space of half a league, that it rather resembles a wall regularly built by the hands of man, than a rock formed in this manner by the operation of Nature. The Nile washes this mountain a long way; and it is distant from Cairo in Upper Egypt four and a half days journey.

To these observations I shall add a remark made by most travellers, that in Arabia the soil is of various natures. The region nearest to Mount Libanus presents nothing but broken and overturned rocks, and is called *Arabia Petrea*. The removal of the soil, by the movement of the waters, has rendered this country almost totally barren; whilst the lighter mud, and all the good earth, have been carried to a greater distance, and deposited in that part of the country called *Arabia Felix*. Besides, the *revers* in Arabia Felix, as well as every where else, are more rugged toward the African sea, *i. e.* to the west, than toward the Red sea, which is on the east.

II.

On the interior Rock of the Globe.

In p. 48 I remarked, that 'solid rocks are often supported by beds of earth, clay, or sand, which have much less specific gravity. This is the case with most hills, as is easily perceived. But in high mountains, the summits are not only rocks, but these rocks are supported by others; and this structure runs through such an extent of country, where one mountain rises out of another, that it is difficult to determine whether they are founded on earth, or of what nature this earth is. I have seen rocks cut perpendicularly for some hundreds of feet; but these rocks rested upon other rocks, without my being able to perceive where they ended. May we not, however, be allowed to conclude from the less to the greater? Since the rocks of small mountains, the bases of which are visible, rest upon earths less heavy and less solid than stone, is it not reasonable to think, that earth is likewise the basis of high mountains?'

I acknowledge, that this conjecture, derived from analogy, is sufficiently founded. The conjecture I then hazarded was written thirty-four years ago. Since that time I have acquired ideas and collected facts which convince me, that the great mountains composed of vitrescent materials, and produced by the action of the primitive fire, are connected immediately with the interior rock of the globe, which is also a vitreous rock of the same kind. These great mountains are a part of this immense rock, and are only prolongations or eminences formed upon the surface of the globe at the time of its consolidation. Hence we ought to regard them as constituent parts of the original mass of the earth. But the hills or smaller mountains, which rest upon clay or vitrifiable sand, have been formed by the motion and sediments of the waters, at a time long posterior to the formation of the great mountains by the primitive fire. It is in these points or projections which form the nucleus of mountains, that the veins of metals, though their height be considerable, are not of the highest kind, but of a mean height, and uniformly arranged, *i. e.* they rise by gradual elevations, and are connected with a considerable chain of mountains, which are occasionally interrupted by valleys.

['The internal parts of the primitive mountains which I have penetrated, either in pits or in the galleries of mines, to the depth of twelve and fifteen hundred feet, are entirely composed of *pure* vitreous *rock*, in which there are slight and irregular fissures, through which the water issues, and vitriolic and metallic solutions. From this fact we may conclude, that the whole nucleus of these mountains is a pure rock, adhering to the primitive mass of the globe. We indeed find upon their sides, and upon the margins of the valleys, masses of clayey earth, and banks of calcareous stones at considerable depths. But these are only the remains of those materials which filled up the cavities of the earth, and must be referred to the second epoch of Nature.'—*Note communicated by M. de Grignon to M. de Buffon.*]

III.

Of the Vitrification of Calcareous Substances.

In page 49 I said, that 'calcareous bodies are alone incapable of being vitrified, and seem to form a distinct class. All other substances may be converted into glass.'

I had not then made those experiments which have since convinced me, that calcareous substances, like all others, may be reduced to glass. To produce this effect nothing more is necessary than a fire more violent than that of our common furnaces. I reduced limestone to glass by a good burning glass. Besides, M. d'Arcet, an able chymist, melted calcareous spar, without the addition of any other matter, by means of a porcelain furnace belonging to M. le Compte de Lauragais. But these operations were performed several years after the publication of my *Theory of the Earth*. I knew only, that in the iron furnaces, the light, white, spungy matter, similar to pumice-stone, which issues from them when overheated, is nothing but a vitreous substance, proceeding from the calcareous bodies thrown into the furnace to assist the fusion of the iron ore. The sole difference between the vitrification of calcareous and vitrescent substances is, that the latter are immediately vitrified by the action of a violent fire alone; but calcareous bodies, before they are vitrified, pass through a state of calcination, and form a line. But like all other substances they vitrify, even in our common furnaces, whenever they are mixed with vitrescent matters, especially with those which, like the *aubue*, or slimy earth, yield most easily to the fire. Hence we may safely conclude, that in general, every material of which this globe is composed may be reduced to its primitive state of glass if a sufficient degree of heat is applied.

ADDITIONS *to the Article concerning Shells, and other Productions of the Sea, found in the interior parts of the Earth,* Vol. I. p. 50.

I.

Of Fossil and Petrified Shells.

FROM what I have written, p. 54, on the subject of the Italian letter, in which it is remarked by this author, 'that the pilgrims brought from Syria, in the time of 'the Crusades, those shells peculiar to the Levant, 'which are now found petrified in France, in Italy, and 'in other parts of Christendom,' I find that I have not treated M. de Voltaire with sufficient respect. I acknowledge, that I should rather have taken no notice of this opinion, than revived it with a jest, especially as humour is not my talent, and as this is perhaps the only example of pleasantry in all my works. M. de Voltaire is a man whose superiority of genius merits the highest regard. I was furnished with this letter at the very time I was correcting the sheet which contains the passage in question. I read part of it only, imagining it to be the production of some learned Italian, who from mere historical knowledge had followed his own prejudices without consulting Nature; and it was not till after my volume on the Theory of the Earth was printed that I knew the letter was written by M. de Voltaire. I then sincerely regretted the expressions I had used. This truth I thought it incumbent on me to make public, as well for the sake of M. de Voltaire, as for my own and that of posterity, to whom I would not leave a doubt of the high esteem I have always had for a man of such uncommon talents, and who has done so much honour to human nature and to the age in which he lived.

As the authority of M. de Voltaire made an impression upon some persons, others have endeavoured to discover whether his objection with regard to the shells found below ground has any foundation. Upon this subject I shall subjoin an extract of a memoir which was transmitted to me, and which appears to have been written with that intention.

In traversing the different provinces of France, and even of Italy, 'I every where saw,' le P. Chabenat remarks, 'figured stones; and in particular places their 'number was so great, and they were arranged in such 'a manner, that it was impossible not to be satisfied 'that these parts of the earth had formerly been covered 'with the sea. I saw shells of every kind, which were 'perfectly similar, both in figure and size, to those which 'now exist. This observation was sufficient to convince 'me, that all these individuals were of different ages, but 'of the same species. I saw cornua ammonis from half 'an inch to near three feet in diameter. I saw cockles 'of all sizes, as well as other bivalves and univalves. I 'likewise saw belemnites, sea mushrooms, &c.

'The form and number of these figured stones prove 'in the most incontestible manner, that they were formerly animals which existed in the ocean. The shells 'with which the moulds are covered seem to remove 'every doubt upon this subject; for in particular specimens it is equally lustrous, fresh, and natural, as in 'the living animal. If separated from the mould or 'nucleus, we could not believe that it was petrified. 'The same observation is applicable to many other 'figured stones found in that beautiful and extensive 'plain which stretches from Montauban to Toulouse, and 'from Toulouse to Alby, as well as to the circumjacent 'places. The whole of this vast plain is covered with 'vegetable soil, from half a foot to two feet thick. 'Below the soil there is a bed of coarse gravel about 'two feet in thickness. The gravel is succeeded by a 'bed of fine sand, which is nearly of an equal thickness; 'and the rock lies immediately under this bed of sand. 'I have repeatedly examined the gravel with the greatest 'attention, and I found it interspersed with an infinite 'number of figured stones of the same form but of 'various sizes. I likewise found a number of sea hedgehogs, and other stones of a regular figure, and perfectly 'similar. All these facts announce, in language the 'most expressive, that this country, as well as many 'others, had formerly been the bottom of the sea, which 'by some sudden revolution had retired, and left its 'various productions behind. I shall, however, suspend 'my judgment, on account of M. de Voltaire's objec- 'tions, to remove which experience and observation 'must be united.'

Le P. Chabenat next subjoins several experiments to prove, that the shells found in the earth are the same with those which still exist in the sea. These experiments I shall not relate, because they contain nothing new; and every man is satisfied, that fossil and marine shells are precisely of the same nature. Le P. Chabenat concludes his memoir with remarking, 'that 'all the shells found in the bowels of the earth are un- 'questionably real shells, and relicks of animals whose 'element is the ocean, which had formerly covered these 'countries; and consequently that the objections of 'M. de Voltaire are ill founded.'

II.

Of the Places where Shells are found, p. 53.

To the enumeration I have given of the great quantities of shells found in all parts of the world, I might add many particular observations which have been communicated to me during these last thirty-four years. I have received letters from the American islands, by which I am assured, that in almost all of them shells are found, either petrified or in their natural state, in the interior parts of the earth, and often below the first stratum or vegetable soil. In the Malouine islands M. de Bougainville found stones which divided into thin plates or leaves, and upon which were impressions of fossil shells, of a species unknown in these seas. To the same purpose I have letters from several parts of India and of Africa. Don Ulloa informs us, that in that district of Chili which extends from Talca Guano to Conception, different kinds of shells are found in great numbers, and without any mixture of earth; and that these shells are used to make lime. He adds, that this peculiarity would not be so remarkable, if these shells were found only in low places which might be covered with the sea. But what is singular, he remarks, that the same heaps of shells are found in the hills at the height of fifty fathoms above the level of the sea. I relate this fact, not because it is singular, but because it corresponds with all the others, and is the only one known to me concerning fossil shells in this part of the world, where I am persuaded that petrified shells will be found as well as every where else, at heights much greater than fifty fathoms above the level of the sea; for the same Don Ulloa has since found petrified shells in the mountains of Peru at the height of above 2000 fathoms; and according to M. Kalm shells are seen in North America upon the tops of several hills: he tells us, that he saw them on the summit of the Blue Mountains. They have also been found in the chalk quarries near Montreal, in certain stones near Lake Champlain in Canada, and in the most northern regions of this New Continent; for the Greenlanders believe, that the world had been drowned by a deluge, and in evidence of this event they quote the shells and the bones of whales which cover the most elevated mountains of their country.

If from this we pass to Siberia we shall find the same proof of the ancient abode of the ocean upon all our Continents. Near the mountain Jeniseik there are other mountains less elevated, upon the summits of which we find heaps of shells well preserved both in figure and natural colours. These shells are all empty, and some of them fall into powder as soon as they are touched. 'The sea of this country produces no shells similar to 'those found on the tops of mountains.' The largest of these shells exceed not an inch in breadth, and others are very small.

But I can exhibit facts which are still more obvious. Every man in his own province has only to open his eyes, and he will see shells in all places where lime-stone is found, as also in most clays, though in general marine productions are more rare in clays than in calcareous substances.

In the territory of Dunkirk, on the top of the mountain of the Recollets, near that of Cassel, and at 400 feet above the level of the sea, there is a horizontal stratum of shells, which are so closely packed together that most of them are broken. Above this stratum there is a bed of earth from seven to eight feet deep. These shells are situated at the distance of six leagues from the sea, and they are of the same species with those found on its coast.

In Mount Gannelon, near Anet, and at some distance from Compiegne, there are several quarries of excellent lime-stone. Between the different strata of the lime-stone we find gravel mixed with an infinite number of sea-shells, or portions of shells, which are very light and friable. In the same place there are common oyster shells in fine preservation, and extend more than a league and a quarter in length. In one of these quarries there are three strata of shells in different states. In two of these strata they are so much broke that their species cannot be distinguished: but in the third there are oysters which have suffered no alteration but that of being excessively dried. The nature, figure, and enamel of the shells, are the same as in the live animals. These shells have acquired a great lightness, and easily exfoliate. The lime-stone quarries are situated at the foot of the mountain, and have a small declivity. In descending towards the plain we find oysters which are neither dried nor have undergone any change, but have the same weight, and the same enamel with those which are daily taken out of the sea.

In the neighbourhood of Paris, these marine shells are not less common. The marl pits of Bougival furnish a kind of middle-sized oysters. They are not entire, but cut in different directions, and finely polished. Near Belleville, where free-stone is quarried, we find a mass of sand in the earth, which contains branched bodies, which may have been corals or madrepores converted into stone. These marine bodies are not in the sand alone, but in the stones, which likewise contain shells of different kinds, as volutes, univalves, and bivalves.

Switzerland is not less abundant in fossil marine bodies than France and the other countries we have mentioned. In Mount Pilate, in the canton of Lucerne, we find petrified sea-shells, and the bodies and relicks of fishes. In the same mountain there are corals, and slates which easily exfoliate, and, between the leaves, a fish is generally found. Some years ago, the jaws, and even entire heads of fishes, together with their teeth, were discovered.

M. Altman remarks, that, in one of the highest parts of the Alps, near Grindelvald, where the famous glaciers (Gletchers) are formed, there are fine marble quarries, which he has represented in one of the engravings of these mountains. The marble quarries are only a few paces distant from the glacier. The marble is of various colours, as white, yellow, jasper, red, and green. The marble is drawn on sledges above the snow as far as Underseen, where they are embarked to be carried to Berne by lake Thorne, and afterwards by the river Are. Thus marble and calcareous stones are found, at great heights, in this part of the Alps.

M. Cappeler, in making researches on Mount Grimsel, one of the Alps, has remarked, that the hills and smaller mountains which limit the valleys, are mostly composed of free-stone, of a grain more or less fine and close. The tops of these mountains generally consist of lime-stone, of various colours and hardness. The mountains more elevated than these calcareous rocks, are composed of granite and other stones, which appear to be of the nature of granite and of emery. It is in these granity stones that rock-crystal begins to be formed. But in the lime-stone rocks below we find nothing but spar and calcareous concretions. In general, it has been remarked, concerning shells of every kind, whether fossil or petrified, that certain species are always found together, and that others are never met with in these places. The same thing happens in the ocean, where particular species of testaceous animals are constantly found together, in the same manner as certain plants always grow together on the surface of the earth.

It has been too generally believed, that, there are no shells, or other productions of the sea, on the highest mountains. It is true, that there are several summits, and a great number of peaks, which are entirely composed of granite and vitrifiable rocks, and in which no mixture can be perceived. These contain neither the moulds of shells, nor the relicks of any marine bodies. But there is a much greater number of mountains, and some of them very high, where these relicks are to be found. M. Costa, professor of anatomy and botany in the university of Perpignan, in the year 1774, discovered, some fathoms below the top of Mount Nas, situated in the middle of the Spanish Cerdagne, and one of the most elevated parts of the Pyrennees, a great number of lenticular stones, *i. e.* blocks composed of lenticular stones, and these blocks were of different figures and different sizes; the largest might weigh from forty to fifty pounds. He remarked, that the part of the mountain where these lenticular stones were found, seemed to have formerly sunk; for in this place he saw an irregular, oblique depression, very much inclined to the horizon; and one of its extremities respected the top, and the other the bottom of the mountain. He could not distinctly perceive the dimensions of this depression, because most of it was covered with snow, though it was the month of August. The banks of rocks which surrounded these lenticular stones, as well as those immediately below, are calcareous for more than a hundred fathoms. This Mount Nas, to judge of it by the eye, seems to be as high as Canigou, and presents no vestige of a volcano.

A thousand other examples of marine shells, found in an infinity of places, as well in France as in different parts of Europe, might be given. But such an enumeration of particular facts, which are already too much multiplied, would swell this work, without answering any useful purpose. From the whole, however, we cannot refrain from drawing this obvious conclusion, that all the inhabited parts of the earth have formerly, and during a very long course of time, been covered with the waters of the ocean.

I shall only remark, that these sea-shells are found in different states. Some of them are petrifactions, or stones moulded into the form of shells; and others are in the same state as they still exist in the ocean. The quantity of petrified shells, which are nothing but stones figured by shells, is infinitely greater than that of fossil shells, and they are never found together, nor even in places contiguous; it is only in the neighbourhood, and some leagues distant from the sea, that we find beds of shells in their natural state, and these are commonly the same with those which exist in the adjacent seas. Petrified shells, on the contrary, are found, almost every where, at great distances from the sea, and on the highest hills, many species of which belong not to our seas, and several of them have no existing representatives;

such as those ancient species we formerly mentioned, which only existed when the globe was much warmer. Of more than a hundred species of cornua ammonis, remarks one of our learned academicians, with which we are acquainted, and which are found in the environs of Paris, of Rouen, of Dive, of Langres, and of Lyons, as well as in the Cevernes, in Provence, in Poitou, in Britain, in Spain, and in other countries of Europe, there is but one species, called the *nautilus papyraceus*, found in our seas, and five or six others produced in foreign seas.

III.

Of those great Volutes called Cornua Ammonis, and of some large Bones of terrestrial Animals.

In p. 56, I said, that 'many shell-fishes inhabit the 'deepest parts of the ocean, and are never thrown upon 'the coasts; authors have, therefore, termed them *pelasgæ*, to distinguish them from the other kinds, which 'they call *littorales*. It is probable that the cornu ammonis, and some other species found only in a petrified 'state, belong to the former, and that they have been 'impregnated with stony matter in the very places where 'they are discovered. It is also probable, that the species of some animals have been extinguished, and that 'these shells may be ranked among this number. The 'extraordinary fossil bones found in Siberia, in Canada, 'in Ireland, and several other places, seem to confirm 'this conjecture; for no animal has hitherto been discovered to whom bones of such enormous size could 'possibly belong.'

Upon this passage I have to make two important remarks:

1. That these cornua ammonis, which are so different from each other both in figure and size, seem to form rather a genus than a species in the class of shell animals, are really the relicks of so many species which have perished, and no longer subsist. I have seen some of them so small, that they exceed not a line, and others so large that they were more than three feet in diameter. Observers worthy of credit have assured me, that they have seen some still larger, and particularly one of eight feet in diameter, and one foot thick. These different cornua ammonis seem to form distinct species. Some of them are more or less fluted. They are all spiral; but they terminate differently, both at their centres and at their extremities. These animals, formerly so numerous, are no longer found in any of our seas. They are known to us by their relicks only; and the immensity of their number cannot be better represented than by an example which I have daily before my eyes. In the iron mine near Etivey, (three leagues from my forge of Buffon,) which has been wrought 150 years, and has supplied the iron works of Aisy during all that time, there are such quantities of cornua ammonis, entire and in fragments, that the greatest part of the ore seems to have been moulded in these shells. The mine of Conflans in Lorrain, which supplies the furnace of St. Loup in Franche-comte, is likewise entirely composed of belemnites and cornua ammonis. These last ferruginous shells are so different in size, that they weigh from a drachm to two hundred pounds. Other places might be mentioned where they equally abound. In the same manner we find belemnites, lenticular stones, and moulds of many other shells, which now no longer exist in any part of the ocean, though they are almost universally diffused over the surface of the earth. I am persuaded that all these lost species formerly subsisted during the the time that the temperature of the earth and waters was warmer than it is at present; and that in proportion as the globe cools, other species which now exist, will perish like the former, for want of heat sufficient to support them.

2. That some of those enormous bones, which I thought had belonged to unknown animals, whose species was supposed to be lost, have, nevertheless, after the most accurate examination, appeared to belong to the elephant and hippopotamus, but to species of these animals much larger than those which now exist.

ADDITIONS *to the Article, Of the Inequalities of the Surface of the Earth,* Vol. I. p. 60.

I.

Of the height of Mountains.

WE remarked, p. 62, that 'the highest mountains in 'the world are the Cordeliers of America, and especially 'that part of them which lies under the Equator, or between the Tropics.' Our mathematicians who were sent to Peru, as well as some other travellers, have measured the height of these mountains above the level of the South Sea. Some of them were measured geometrically, and others by the barometer, which, being subject to little variation in that climate, gives the height nearly as exact as a geometrical measurement. The following are the results of these observations.

Heights of the most elevated Mountains of the Province of Quito in Peru.

	Fathoms.
Cota-caché, to the north of Quito	2570
Cayambé-orcou, under the Equator	3030
Pitchincha, a volcano in 1539, 1577, and 1660	2430
Antisana, a volcano in 1590	3020
Sinchoulogoa, a volcano in 1660	2570
Illinica, supposed to be a volcano	2717
Coto-paxi, a volcano in 1533, 1742, and 1744	2950
Chinboraco, a volcano; the date of its eruption unknown	3220
Cargavi-raso, a volcano in 1698	2450
Tongouragoa, a volcano in 1641	2620
El-altan, one of the mountains called Coillanes	2730
Sanguai, a volcano which has burnt since the year 1728	2680

By comparing the heights of the mountains of South America with those of our Continent, we will perceive that in general they are one fourth part higher than the mountains of Europe, and that almost the whole of them have been and actually are volcanoes. But even the highest mountains in the interior parts of Europe, Asia, and Africa, have been extinguished long beyond the record of history. It is true, that in several of these last mountains we evidently recognise the ancient existence of volcanoes, as well by the black and burnt sides of precipices, as by the nature of the matters which surround them, and which extend along the ridges of the mountains. But as these mountains are situated in the interior parts of Continents, and now very distant from the sea, the action of the subterraneous fires, which cannot produce great effects but by the shock of water ceased after the seas retired. It is for this reason, that in the Cordeliers, whose roots may be said to border upon the South Sea, most of the peaks are actual volcanoes; whilst the volcanoes of Auvergne, Vivarais, Languedoc, Germany, Switzerland, &c. in Europe, and those of Mount Ararat in Asia, and Mount Atlas in Africa, have long been absolutely extinct.

The height at which vapours freeze is about 2400 fathoms in the Torrid Zone, and about 1500 in France. The tops of high mountains sometimes surpass this line from 800 to 900 fathoms, and all this space is covered with snow which never melts. The highest clouds rise not above 300 or 400 fathoms above these mountains, and consequently exceed the level of the sea about 3600 fathoms. Hence, if the mountains were still higher, we should see in the Torrid Zone a belt of snow commencing at 2400 fathoms above the level of the sea, and terminating at 3500 or 3600 fathoms, not on account of the cessation of the cold, which augments in proportion to the elevation, but because the vapours would not rise higher.

M. de Keralio, a learned philosopher, has collected the heights of the mountains in several countries, from the measurements of different persons.

In Greece M. Bernouilli determined the height of Mount Olympus to be 1017 fathoms. Hence the snow cannot lie upon it perpetually; neither can snow lie constantly on Pelion in Thessaly, nor on Cathalylium and Cyllene; because the height of these mountains does not rise to the freezing degree. M. Bougner assigns 2500 fathoms as the height of the Peak of Teneriff, the top of which is always covered with snow. Mount Ætna, the Norwegian Mountains, the Hemus, the Athos, the Atlas, the Caucasus, and several others, such as Mounts Ararat, Taurus, and Libanus, are perpetually covered with snow near their summits.

	Fathoms.
Pontoppidan informs us that the highest mountains of Norway are	3000
Note—This measure, as well as the following, appears to be exaggerated.	
According to M. Brovallius, the highest mountains of Sweden are	2333
The following, according to the Memoirs of the Academy of Sciences, are the highest mountains of France,	
Le Cantal	984
Mount Ventoux	1036
Le Canigou of the Pyrenees	1441
Le Moussec	1253
Le Saint Barthelemy	1184
The Mountain of Gold in Auvergne, an extinguished volcano	1048
According to Mr. Needham the height of the mountains of Savoy are,	
The Convent of St. Bernard	1241
The Rock to the south of St. Bernard	1274
Mount Serène	1282
L'Allée Blanche	1249
Mount Tourne	1683
According to M. Facio de Duiller, Mount Blanc, or the Cursed Mountain, is	2213

It is certain, that the chief mountains of Switzerland are higher than those of France, Spain, Italy, and Germany. Several learned men have ascertained the height of these mountains.

The greatest part of these mountains, according to M. Mikheli, as the Wetter-horn, the Shreck-horn, the Eighess-Schneeberg, the Fisher-horn, the Stroubel, the Fourke, the Louk-marier, the Crispalt, the Mougle, the ridge of Baduts and Gottard, are from 2400 to 2750 fathoms above the level of the sea. But these measures, I suspect, are too high, especially as they exceed by one half those given by Cassini, Scheuthzer, and Mariotte, which may be estimated too low, but not to this extent.

My suspicion is farther confirmed, by considering that, both in the cold and temperate regions, where the air is always troubled with storms, the barometer is subject to so great variations, that its results cannot be trusted.

II.

Of the Direction of Mountains.

In vol. I. p. 63, I remarked, that 'the direction of the 'great mountains of America is from north to south, 'and that those of the Old Continent run from west to 'east.' This last assertion requires to be modified; for though, at first sight, we may follow the mountains as far as China, by passing from the Pyrennees in Auvergne, to the Alps in Germany, and in Macedonia, to Caucasus and other mountains of Asia, as far as the Tartarian sea; and though Mount Atlas, in the same manner, appears to traverse the Continent of Africa from west to east, the middle of this vast peninsula may still consist of a chain of high mountains stretching from Mount Atlas to the Mountains of the Moon, and from these to the Cape of Good Hope: in this view, the middle of the Continent of Africa may be considered as consisting of mountains which run from north to south through its whole extent, like the mountains of America. Those parts of Mount Atlas which traverse Africa from west to east, should be considered as branches only of the principal chain. The mountains of the Moon, which run from west to east, may likewise be regarded as collateral branches; and, if there are no volcanoes in this prodigious range of mountains, it may be owing to the vast distance of the sea from the middle regions of Africa; whilst, in America, the sea is very near the foot of the high mountains, which, instead of occupying the middle of the peninsula of South America, are all situated to the west; and the extensive low lands are entirely on the east side.

The great chain of the Cordeliers are not the only mountains of America which run from north to south. In the territory of Guiana, about one hundred and fifty leagues from Cayenne, there is a chain of pretty high mountains, which also extends from north to south. On the Cayenne side, this chain is so steep, that these mountains are almost inaccessible. This steepness seems to indicate, that, on the other side, the declivity is gentle, and consists of fine land. The tradition of the country, accordingly, or rather the testimony of the Spaniards, is, that, beyond the mountains, there are populous nations of savages united into regular societies. It is likewise said, that there is a gold mine in these mountains, and a lake in which grains of gold are found: but this fact requires confirmation.

In Europe, the chain of mountains which begins in Spain, and passes through France, Germany, and Hungary, divides into two great branches, one of which extends into Asia by the mountains of Macedonia, Caucasus, &c. and the other branch stretches from Hungary into Poland and Russia, and extends as far as the sources of the Wolga and Boristhenes; and, stretching still farther, it joins another chain in Siberia, and terminates in the north sea to the west of the river Oby. These chains of mountains ought to be regarded as one continued ridge, from which several large rivers derive their sources: some of these rivers, as the Tagus, and the Doura in Spain, the Garonne and the Loire in France, and the Rhine in Germany, empty themselves into the ocean; others, as the Oder, the Vistula, and the Niemen, fall into the Baltic sea; others, as the Dwina, fall into the White sea, and the river Petzora empties itself into the Frozen sea. On the east side, this chain of mountains gives rise to the Yeucar and Ebro in Spain, to the Rhone in France, and to the Po in Italy, which fall into the Mediterranean; to the Danube and Don, which lose themselves in the Black Sea; and, lastly, to the Wolga, which falls into the Caspian.

Norway is full of rocks and groups of mountains. There are plains, however, which extend, without interruption, six, eight, and ten miles. Their direction is not from west to east, like that of the other European mountains. On the contrary, they stretch, like the Cordeliers, from south to north.

In the south of Asia, from the island of Ceylon to Cape Comorin, there is a chain of mountains which separates Malabar from Coromandel, traverses the Mogul country, joins Mount Caucasus, stretches through the country of the Calmucks, and terminates in the North Sea to the east of the Irtis. Another chain extends from north to south as far as Razatgat in Arabia, and may be traced, at some distance from the Dead Sea, as far as Jerusalem: it surrounds the extremity of the Mediterranean, and the point of the Black Sea, from which it traverses Russia, and terminates in the North Sea.

We may likewise remark, that the mountains of Indostan and those of Siam run from south to north, and both unite with the rocks of Thibet and Tartary. Each side of these mountains presents a different season: on the west, they have six months of rain, while, on the east, they enjoy the finest weather.

All the mountains of Switzerland, as those of the Vallese and the Grisons, those of Savoy, Piedmont, and Tirol, form a chain, which extends, from north to south, as far as the Mediterranean. Mount Pelate, which is situated in the centre of Lucerne, nearly in the centre of Switzerland, forms a chain of about fourteen leagues, extending from north to south as far as the canton of Bern.

We may, therefore, conclude in general, that the greatest eminences of this globe are situated from north to south, and that those which run in other directions ought to be regarded as collateral branches only of these primitive mountains: and it is partly by this disposition of the primitive mountains, that all the points or terminations of continents are either south or north ; as appears from the points of Africa, of America, of California, of Greenland, of Cape Comorin, of Sumatra, of New Holland, &c. This fact seems to prove, as formerly remarked, that the waters have proceeded in greater quantities from the south than from the north pole.

If we consult a new map of the world, in which are represented, round the Arctic Pole, all the lands of the four quarters of the globe, except the north point of America, and round the Antarctic Pole, all the seas, and the small portions of land to be found in the southern hemisphere, we shall evidently perceive that many more revolutions have happened in the latter than in the former hemisphere, and that the quantity of water has always been, and still is, much greater there than in our hemisphere. Every thing concurs in proving, that the greatest inequalities of the globe exist in the southern regions, and that the general direction of the primitive mountains is from north to south, rather than from east to west, through the whole extent of the earth's surface.

III.

Of the Formation of Mountains.

All the valleys and dales on the surface of the globe, as well as all the mountains and hills, have originated from two causes, namely, fire and water. When the earth first assumed its consistence, a number of inequalities took place on its surface; swellings and blisters arose, as happens in a block of glass or of melted metal. Hence this first cause produced the original and the highest mountains, which rest on the interior rock of the earth as their base, and below which, as every where else, there must have been vast caverns, which sunk in at different periods. But without considering this second event, the falling in of the caverns, it is certain, that, when the earth first consolidated, it was every where furrowed with depths and eminences, which were produced solely by the action of cooling. Afterwards, when the waters were precipitated from the atmosphere, which happened when the earth cooled so much as to be unable to repel the vapours, these waters covered the whole surface of the globe to the height of two thousand fathoms ; and, during their long abode upon our continents, the motion of the tides and that of the currents, changed the disposition of the primitive mountains and valleys. These movements would form hills in the valleys, and would cover the bottoms and knaps of the mounts with new beds of earth ; and the currents would produce furrows or valleys with corresponding angles. It is to these two causes, of which the one is much more ancient than the other, that the present external form of the surface of the earth is to be referred. Afterwards, when the seas sunk down, they produced those steep precipices on the west, where they ran with the greatest rapidity, and left gentle declivities on the east.

The structure of those eminences which were formed by the sediments of the ocean, is very different from that of those which owe their origin to the primitive fire. The first are disposed in horizontal beds, and contain an infinite number of marine productions. The second, on the contrary, are less regular in their structure, and include no marks of sea-bodies. These mountains of the first and second formation, have nothing in common but the perpendicular fissures ; but these fissures are effected by two different causes. The vitrescent matters, in cooling, diminished in size, and of course they split, and receded to different distances. But those composed of calcareous matters transported by the waters, split into fissures solely by drying.

I have often remarked, that, in detached hills, the first effect of the rains is gradually to carry down from the summit the earth and other bodies, which form at the foot a pretty thick stratum of good soil, while the top is left entirely bare. This effect is, and necessarily must be, produced by the rains. But a previous cause disposed these and similar matters round all hills, not excepting those which are detached; for, on one side the earth is uniformly better than on the other other : the hills are always steep and precipitant on one side, and have a gentle declivity on the other ; which proves clearly that the action, as well as the direction of the motion of the waters, were greater on one side than on the other.

IV.

Of the Density which certain Matters acquire by Fire, as well as by Water.

In p. 64, I said, ‘ that the hard points found in free-‘ stone consisted of metallic matter, which appeared to ‘ have been melted by a strong fire.’ This assertion seems to insinuate that the great masses of free-stone have originated from the action of the primitive fire. I at first imagined that this matter owed its density and the adhesion of its particles solely to the intervention of water. But I have since learned that the action of fire produces the same effect ; and I shall relate some experiments which at first surprised me, but which I have repeated so often as to remove every doubt upon this subject.

EXPERIMENTS.

I pounded free-stones of different degrees of hardness, till they were reduced to a powder more or less fine. These powders I employed to cover the cements I used in converting iron into steel. This powder of free-stone was strewed over the cement, and heaped up, in the form of a dome of three or four inches in thickness, on an earthen vessel of three feet long by two broad. After undergoing the action of the fire in my blast furnaces, during several days and nights without interruption, it was no longer the powder of free-stone, but a mass so solid that we were obliged to break it in order to uncover the vessel which contained the iron, now converted into steel. The action of fire upon this powder of free-stone produced masses equally solid as free-stone of a middling quality, which does not ring under the hammer. This fact showed that fire, as well as water, could prove a cement to vitrifiable sand, and consequently might have formed those immense masses of free-stone which compose the nucleus of some of our mountains.

I am, therefore, fully persuaded, that all the vitrescent matters, of which the interior rock of the globe, as well as the nuclei of great mountains, are composed, have been produced by the action of the primitive fire; and that the waters have only formed those accessory strata which surround these nuclei, which are all parallel and horizontal, or equally inclined, and in which we find the relics of shells and other productions of the ocean.

In the formation of free-stone and other vitrescent matters, I pretend not to exclude the intervention of water. On the contrary, I am inclined to believe, that vitrifiable sand may acquire consistence, and unite into masses more or less hard, perhaps more easily by means of water than by the action of fire. I have related the above facts solely with the view of preventing objections which would not fail to be made, if it had been thought that I attributed the solidity of free-stones, and other bodies composed of vitrifiable sand, to the intervention of water alone. It is certain that all the free-stone found on the surface, or at inconsiderable depths, have been formed by water; for on the surface of these masses of free-stone we perceive marks of undulations and rollings, and sometimes the impressions of plants and shells. But the free-stones formed by the sediments of water are easily distinguished from those which have been produced by fire. The latter have a coarser grain, and crumble down more easily than free-stone cemented by the intervention of water, which is more compact and harder than that whose particles have been united by the action of fire.

Ferruginous matters assume a great degree of hardness by fire; for nothing is harder than cast iron. But ferruginous bodies may likewise acquire considerable density by the intervention of water. Of this fact I was ascertained by putting a quantity of filings of iron into vessels exposed to the rain. These filings formed a mass so hard that it could only be broken by the hammer.

The vitreous rock which composes the interior mass of the globe is harder than common glass. But it is not harder than certain volcanic lavas, and much softer than cast iron, which, however, is only glass mixed with ferruginous particles. This great hardness of the interior rock shows that it consists of the most fixed particles of matter, and that from the time of their consolidation they assumed the consistence and hardness which they still possess. Hence it cannot be objected to my hypothesis of general vitrification, that bodies reduced to glass by our furnaces are less hard than the rock of the globe; since cast iron, some lavas, or basalts, and even certain porcelains, are harder than this rock, and yet they derive their hardness from the action of fire alone. Besides the elements of iron and other minerals which give hardness to matters liquified by fire, or attenuated by water, existed, as well as the fixed earth, from the time that the globe was first consolidated: and I have already remarked, that the interior rock ought not to be regarded as pure glass, similar to that we make with sand and salts, but as a vitreous product mixed with matters the most fixed, and most capable of supporting the great and long continued action of the primitive fire, the great effects of which can only be compared in a very distant manner with the inconsiderable operations of our furnaces; and yet from this comparison, though unfavourable, we clearly perceive what effects are common to the primitive fire and to our furnaces; and it shows at the same time that the degree of hardness depends less on the degree of heat than on the combination of matters submitted to its action.

V.

Of the inclination of the Strata in the Mountains.

I remarked in Vol. I. p. 46, that 'in plains the strata 'are exactly horizontal. It is in the mountains only 'that they are inclined to the horizon; because they 'have originally been formed by sediments deposited 'upon an inclined base.'

The beds of calcareous matters are not only horizontal in the plains, but likewise in all mountains which have not been disturbed by earthquakes or other accidental causes: and when the strata are inclined, the whole mountain is likewise inclined, and has been forced into that position by a subterraneous explosion, or by the sinking of a part of the earth, which had served it as a basis. We may therefore conclude in general, that all strata formed by the sediments of waters are horizontal, like the water itself, except those which have been formed on an inclined base, as is the case with the most part of coal mines.

The most external part of the earth, whether in plains or mountains, is solely composed of vegetable earth, which owes its origin to sediments of the air, of vapours, and of dews, and to the successive destruction of herbs, leaves, and other parts of decomposed plants. This first stratum every where follows the declivities and curvatures of the earth, and is more or less thick according to particular local circumstances. The vegetable stratum is commonly much thicker in valleys than on hills; and its formation is posterior to that of the primitive strata of the globe, the most ancient and most internal of which have been formed by fire, and the newest and most external have derived their origin from matters transported and deposited in the form of sediments by the motion of the waters. These in general are horizontal; and it is only by the action of particular causes that they sometimes appear inclined. The beds of calcareous stones are commonly horizontal, or slightly inclined; and of all calcareous substances the beds of chalk preserve their horizontal position most exactly. As chalk is only the dust of decayed calcareous bodies, it has been deposited by waters whose movements were tranquil, and their oscillations regular; whilst the matters which were only broken into large masses, have been transported by currents, and deposited by the removal of the waters; which is the reason why their strata are not so perfectly horizontal as those of chalk. The high coasts of Normandy are composed of horizontal strata of chalk so regularly perpendicular, that at a distance they have the appearance of fortified walls. Between the strata of chalk there are small beds of black flint which give rise to the black veins in white marble.

[On the tops of some mountains the surface is absolutely naked, and presents nothing to the view but pure rock or granite, without any vegetation, except in the small fissures, where the wind has transported sand, and collected the particles of earth which float in the air. At some distance from the last branch of the Nile, there is a mountain composed of granite, of porphyry, and of jasper, which extends more than twenty leagues in length, by perhaps an equal number in breadth. The surface of the summit of this enormous quarry, we are assured, is absolutely devoid of vegetables, and forms a vast desert, where neither quadrupeds, nor birds, nor even insects, can exist. But exceptions of this kind, which are particular and local, merit no consideration.]

Beside the calcareous shells, the strata of which are slightly inclined, and whose position has never been changed, there are many others which have been deranged by different accidents, and which are all much inclined. Of these there are many examples in various parts of the Pyrenees, some of which are inclined forty-five, fifty, and even sixty degrees below the horizontal line. This circumstance seems to prove, that great changes have been produced in these mountains by the sinking of subterraneous caverns which had formerly supported them.

VI.

Of the Peaks of Mountains.

I endeavoured to explain, Vol. I p. 49, how the peaks of mountains had been deprived of the vitrifiable sands with which they had been originally invested; and my explanation errs in this circumstance only, that I attributed the first formation of the rocks which form the nuclei of these peaks to the intervention of water, instead of ascribing it to the action of fire. These peaks or horns of mountains are nothing but prolongations of the interior rock of the globe, which were environed with great quantities of scoriæ and dust of glass. These loose materials must have been carried down by the movement of the sea when it made its retreat. Afterwards, the rains and torrents of water would soon deprive the masses of pure rock of all their coverings, and make them completely bare, as they are at present. I may remark in general, that no other change falls to be made in my theory of the earth than the following fact, that the first mountains derived their origin from the primitive fire, and not from the intervention of water, as I had conjectured; because I had then been induced to believe, by the authority of Woodward and some other naturalists, that shells were found on the tops of all mountains. But from more recent observations, it appears, that there are no shells on the highest summits, nor above two thousand fathoms above the level of the sea. Hence the waters have never surmounted those high summits, or at least have remained but a short time upon them; so that they have formed only the hills and the calcareous mountains, which never rise to the height of two thousand fathoms.

Additions to the Article, Of Rivers, Vol. I. p. 65.

I.

Additional Observations on the Theory of running Waters.

PAGE 69. Concerning the theory of running waters, I have to add a new observation which I made since I established mills, by which the different celerities of water may be pretty accurately ascertained. These mills are composed of nine wheels, some of which are impelled by a fall of water of two or three feet, and others by a fall of five or six feet high: I was at first surprised to find, that all the wheels turned more quickly in the night than in the day, and that the difference was greater in proportion to the height and breadth of the column of water. For example, if the water falls six feet, the wheel will turn a tenth, and sometimes a ninth quicker in the night than in the day; and, if the fall is less high, the difference of celerity will likewise be less; but it is always so sensible as to be easily recognized. I ascertained this fact by placing white marks upon the wheels, and reckoning the number of revolutions in equal times, both during the day and the night; and I uniformly found, by a great number of observations, that the time when the wheels moved with the greatest celerity was the coldest hour of the night, and that they moved slowest when the heat of the day was greatest. In the same manner, I afterwards found, that the celerity of all the wheels is greater in winter than in summer. These facts, which have escaped the observation of philosophers, are of importance in practice. The theory of them is extremely simple: this augmentation of celerity depends solely on the density of the water, which is increased by cold and diminished by heat: and, as the same volume of water only can pass by the trough, this volume, which is denser in winter and during the night, than in summer or in the day, acts with more force on the wheel, and of course communicates to it a greater quantity of motion. Thus, *cœteris paribus*, there will be less loss of water, if we stop the machines during the heat of the day, and work them during the night. By observing this method in my forges, its influence in the process of making iron amounted to one twelfth part.

Another observation merits attention: of two wheels the one nearer the canal than the other, but perfectly equal in every other respect, and both moved by an equal quantity of water, the wheel nearest the canal moves quicker than the one more remote, and to which the water cannot arrive till after it has run over a certain space in the particular runner that terminates in this wheel. It is well known that the friction of water on the sides of a canal diminishes its celerity. But this circumstance is not sufficient to account for the considerable difference in the motion of these two wheels. It is owing in the *first* place, to the water in this canal not being pressed laterally, as it is when it enters by the trough of the canal, and to its striking immediately the ladles of the wheel. *Secondly*, This inequality of motion, depending on the distance of the wheels from the canal, is likewise owing to the water, which passes through a trough, not being a column of equal dimensions with the trough; for the water, in its passage, forms an irregular cone, which is depressed on the sides in proportion to the breadth of the volume of water in the canal. If the ladles of the wheel are very near the trough, the water acts very near as high as the aperture of the trough: but, if the wheel is more distant from the canal, the water sinks in the runner, and strikes not the ladles of the wheel at the same height, nor with equal celerity, as in the first case. The union of these two causes produces that diminution of celerity in wheels which are distant from the canal.

II.

On the Saltness of the Sea, p. 84.

ON this subject there are two opinions, and both of them are partly true. Halley attributes the saltness of the sea solely to the salts of the earth carried down by the rivers; and even supposes that the antiquity of the world may be discovered by the degree of saltness in the waters of the ocean. Leibnitz, on the contrary, believes, that the globe having been liquified by fire, the salts and other empyreumatic substances produced with the aqueous vapours a salt lixivium, and, consequently, that the sea received its saltness from the beginning. The opinions of these two great philosophers, though opposite, should be united, and may even coincide with my own. It is extremely probable, that, at the beginning, the action of the fire combined with that of water dissolved all the saline substances on the surface of the earth; and, of course, that the first degree of saltness in the sea proceeded from the cause assigned by Leibnitz; but this prevents not the second cause assigned by Halley from having considerable influence upon the actual degree of saltness in the sea, which must always augment, because the rivers incessantly carry down great quantities of fixed salts, which cannot be abstracted by evaporation. They remain, therefore, mixed with the general mass of waters, which are, in general, more salt in proportion to their distance from the mouths of rivers, and where the heat of the climate produces the greatest evaporation. That the second cause acts more powerfully than perhaps the first, is proved by this circumstance, that all lakes from which rivers issue are not salt, but almost all those which receive rivers and discharge none, are impregnated with salt. The Caspian Sea, Lake Aral, the Dead Sea, &c. owe their saltness solely to the salts transported thither by the rivers, and which cannot be carried off by evaporation.

III.

Of perpendicular Cataracts.

I remarked, that the cataract of Niagara in Canada was the most famous, and that it fell from a perpendicular height of 156 feet. I have since been informed, that there is a cataract in Europe, which falls from a height of 300 feet. It is that of *Terni*, a small village on the road from Rome to Bologna. It is formed by the river Velino, which derives its source from the mountains of Abbruzzo. After passing by *Riette*, a village on the frontier of the kingdom of Naples, it falls into the Lac de Luco, which seems to be supplied by abundant sources; for the river runs out of it with more force than it enters, and proceeds to the foot of the mountain *del Marmore*, from which it is precipitated by a fall of 300 feet. It is received by a kind of abyss, from which it escapes with great tumultuousness. The celerity of its fall breaks the water with such force against the rocks and the bottom of the abyss, that a humid vapour arises, in which many rainbows of various sizes are formed by the rays of the sun; and, when the south wind blows, and drives this mist against the mountain, instead of several small rainbows, the whole cascade is crowned with a very large one.

Additions and Corrections to the Article, Of Seas and Lakes, Vol. I. p. 75.

I.

Of the Limits of the South Sea.

THE South Sea is much broader than the Atlantic, and appears to be bounded by two chains of mountains, which correspond as far as the equator. The first chain is composed of the mountains of California, of New Mexico, of the Isthmus of Panama, of the Cordeliers, of Peru, of Chili, &c. The other chain stretches through Kamtschatka, Yesso, and Japan, and extends as far as the Larron islands, and even the New Philippines. The direction of these chains of mountains, which appear to be the ancient limits of the Pacific Ocean, is precisely from north to south; so that the Old Continent was bounded on the east by one of these chains of mountains, and the New Continent by the other. Their separation happened at the period when the waters, proceeding from the south pole, began to run between these two chains of mountains, which seem to unite, or at least to make a very near approach to each other towards the northern regions. This is not the only indication of the ancient union of the two continents on the north. This continuity of the two continents between Kamtschatka and the most western lands of America, seems now to be proved by the new discoveries of navigators, who have found, under the same parrellel of latitude, a great number of islands lying so near each other, as to leave only small intervals of sea between the east of Asia and the west of America under the Polar Circle.

II.

Of double Currents in some parts of the Ocean.

I HAD too generally and too positively asserted, that, in no part of the sea, a superior and inferior current are to be found.

I have since received information, which seems to prove, that this effect actually exists, and can even be demonstrated, in certain parts of the sea. On this subject, M. Deslandes, an able navigator, obligingly communicated to me the following accurate remarks, in two letters, the one dated December 6, 1770, and the other November 5, 1773.

'In your Theory of the Earth, Art. XI. Of Seas 'and Lakes, you say, that a double current has been 'alledged to run through the straits of Gibraltar; but 'that those who support this opinion have been de'ceived by the regorging of the water near the shores, 'which often produces a motion opposite to that of the 'principal current.

'After reading this passage, I determined to transmit 'you my observations on this subject.

'Two months after my departure from France, I reconnoitred the land between Cape Gonsalvas and Saint 'Catharine. The force of the currents, the direction of 'which is to the north north-west, corresponding exactly with the situation of the lands, obliged me to 'cast anchor. The general winds of this region blow 'from the south south-east, south south-west, and south-west. I spent two months and a half in making fruitless attempts to change my situation, and to reach the 'coast of Loango, where I had some business to transact. During this time I remarked, that the sea descended in the above direction from half a league to a 'league in the hour, and that at certain depths the currents ascended below with the same rapidity as they 'descended above.

'I ascertained the depth of these opposite currents 'in the following manner. Being moored in eight 'fathoms water, and the sea extremely clear, I fixed a 'lead of thirty pounds weight to the end of a line. At 'about two fathoms from the lead I tied a table napkin 'to the line by one of its corners, and allowed the lead 'to sink in the water. As soon as the table napkin entered it took the direction of the first current. Continuing to observe it, I made it descend. Whenever I 'perceived that the current discontinued, I stopped. It 'then floated indifferently around the line. In this 'place therefore the run was interrupted. I then sunk 'the table napkin about a foot lower, and it assumed 'an opposite direction. By marking the line at the 'surface of the water, I found that the table napkin was 'at the depth of three fathoms; from which I concluded, 'after different examinations, that of eight fathoms 'water three ran north north-west, and five ran in the 'contrary direction of south south-east.

'The same day I repeated the experiment in fifty 'fathoms water, being then distant from the land six or 'seven leagues. I was surprised to find that the upper 'current was deeper in proportion to the depth of the 'bottom. Of fifty fathoms water I reckoned that from 'twelve to fifteen ran in the first direction. This phænomenon did not take place during the whole two 'months and a half that I remained on this coast, but 'nearly one month only, and at different times; during 'these interruptions the whole water ran into the gulf 'of Guinea.

'This opposition of currents suggested the idea of a 'machine, which being sunk as far as the inferior current, and presenting a great surface, might force my 'vessel against the superior current, I made the experiment in miniature upon a boat; and I proceeded so 'far as to produce an equilibrium between the force of 'the superior current, joined to that of the wind, upon 'the boat, and the force of the inferior current upon 'the machine. I had not an opportunity of making 'trials on a larger scale. What I have related, Sir, is a 'truth which may be confirmed by every navigator who 'has visited these climates.

'I imagine that the winds, as well as the rivers, which 'discharge themselves into the sea along this coast, and 'carry great quantities of earth into the gulf of Guinea, 'are the principal causes of these effects. Besides, the 'bottom of this gulf, which by its declivity obliges the 'tide to run retrograde whenever it arrives at a certain 'level, and is incessantly pressed by fresh quantities, 'while the wind acts in a contrary direction upon the 'surface, and constrains part of the water to observe its 'ordinary course. This seems to be the more probable, 'because the sea enters from all quarters into this gulf, 'and issues only by revolutions which seldom happen. 'The moon has no apparent effect; for the same thing 'takes place during all its phases.

'I had occasion to be still farther convinced that the 'pressure of the water, when it comes to its level, 'joined to the inclination of the bottom, are the sole 'causes of this phenomenon. I found that these currents exist only in proportion to the smaller or greater 'declivity of the shores; and I have every reason to 'believe, that they are not perceived beyond twelve or 'fifteen leagues from land, which is the greatest distance along the coast of Angola, where we can be certain of finding the bottom.

'The following circumstances seem to prove, that 'similar changes in the currents take place in the open 'sea. I made one of my experiments at a mean depth, 'namely, thirty-five fathoms. I found at the depth of 'six or seven fathoms that the course of the water ran 'north north-west. On sinking two or three fathoms 'more my line stretched to the west north-west. At 'three or four fathoms deeper the course was west 'south-west, then south-west and south. Lastly, at 'twenty-five and twenty-six fathoms the course was 'south south-east, and towards the bottom it was south-east and east south-east. From these experiments I 'drew the following conclusions: that I might compare 'the ocean between Africa and America to a great river, 'the course of which is almost constantly directed to 'the north-west; that as it runs along it carries down 'sand and mud, which it deposits on its banks. These 'banks are of course heightened, and necessarily raise 'the level of the water, and oblige it to run retrograde 'in proportion to the declivity of the shore. But as the 'water is directed by a primitive impulse, it cannot 'return in a straight line: obeying the original movement, and yielding reluctantly to the last obstacle, it 'must necessarily describe a curve of greater or smaller 'extent, till it meets the middle current, with which it 'may partly unite, or which may serve it as a fulcrum, 'and give it a direction contrary to that impressed on it 'by the bottom. As the mass of water is in perpetual 'motion, the water towards the bottom, being nearer 'the cause, and more pressed, must always undergo the 'first changes, and run in a direction contrary to the 'superior current, while the same cause reaches not 'different heights. These, Sir, are my ideas. I have 'frequently taken advantage of these inferior currents; 'by sinking a machine to different depths, according to 'the number of fathoms water I happened to be in, I 'was enabled to sail against the upper current. I found, 'that in calm water, and with a surface three times 'larger than that part of the prow which is below the 'water, we could run from a third to half a league in the 'hour. Of this fact I was ascertained by my latitude, 'by boats which I anchored, and from which I found 'myself at a great distance an hour afterward; and 'lastly, by the distance of certain points along the 'coasts.'

These observations of M. Deslandes seem to be decisive, and I accede to them with pleasure. I cannot sufficiently thank him for demonstrating not only that my ideas on this subject were in general just, but that in particular circumstances they were liable to exceptions. It is not less certain, however, that the ocean forced open the strait of Gibraltar, and consequently that the Mediterranean sea received a great augmentation by this irruption. I rested this opinion not only on the current of the ocean into the Mediterranean, but on the situation of the land and the correspondence of the strata on the opposite coasts, which has often been remarked by intelligent navigators. 'The irruption which formed the 'Mediterranean is evident, as well as that of the Black 'Sea by the strait of the Dardanelles, where the current 'is always violent, and the correspondence of the angles 'of the two coasts strongly marked, as well as the similarity of the strata, which are precisely the same on 'the opposite sides.'

Besides, the idea of M. Deslandes, who considers the sea between Africa and America as a great river, the course of which is toward the north-west, agrees perfectly with what I advanced concerning the water's running in greater quantity from the south than from the north pole.

III.

Of the Northern Parts of the Atlantic Ocean.

On viewing the islands and gulfs, which are very numerous round Greenland, it is difficult, as navigators remark, not to suspect that the sea falls back from the Poles toward the Equator. What favours this conjecture the tide rises eighteen feet at Cape des Etats, and only eight feet in the bay of Disko, *i. e.* at ten degrees of higher latitude.

This observation, joined to that of the preceding article, seems still farther to confirm the movement of the waters of the ocean from the southern to the northern regions, where they are forced, by the resistance of the lands, to regorge or flow back toward the south.

In Hudson's bay vessels have to preserve themselves from mountains of ice, which are said to be from fifteen to eighteen hundred feet thick, and which being formed by a succession of long winters in small gulfs perpetually filled with snow, have been detached by the north-west winds, or by some other powerful cause.

The north-west wind, which prevails perpetually during winter, and often in summer, excites in the same bay dreadful tempests. These are still more to be apprehended, because shoals are here very frequent. In the countries which bound this bay, the sun never rises or sets without a great cone of light. When this phenomenon disappears, it is succeeded by the aurora borealis. Here the heavens are seldom serene. In spring and autumn the air is generally replete with thick fogs; and during winter with an infinity of small threads of ice, which are visible to the eye. Though the summer heats are considerable during two months or six weeks, thunder and lightning are rare.

The sea along the coasts of Norway, which are bordered with rocks, is commonly from a hundred to four hundred fathoms deep, and the water is less salt than in warmer climates. The number of oily fishes with which this sea is filled, renders it so fat that it is almost inflammable. The tide is here inconsiderable, the highest not rising above eight feet.

Some observations have lately been made upon the temperature of the land and water in the climates adjacent to the north pole.

'In Greenland the cold begins with the new year, 'and becomes so piercing in the months of February and 'March, that the stones split, and the sea smokes like a 'furnace, especially in the bays. In the midst of this 'thick fog, however, the frost is not so intense, as when 'the sky is unclouded; for when we pass from the land 'to that foggy atmosphere which covers the surface and 'margins of the waters, we feel a milder air, though our 'hair and clothes are stiffened with hoar frost. This fog 'produces more chilblains than a dry cold; and when it 'passes from the sea to a colder atmosphere, it instantly 'freezes, is dispersed through the horizon by the wind, 'and produces a cold so intense that no person can go 'into the open air without running the hazard of having 'his hands and feet entirely frozen. It is in this season 'that we see the water freeze on the fire before it boils. 'It is then that the winter paves a road of ice between 'islands, and in the bays and straits.

‘ Autumn is the finest season in Greenland. But its duration is short, and frequently interrupted by cold frosty nights. It is also about this time, that, in an atmosphere darkened with vapours, we see fogs which freeze and form a tissue on the sea similar to cobwebs; and, in the fields, the air is impregnated with lucid atoms, or sharp icicles like small needles.

‘ It has often been remarked, that the seasons in Greenland assume a temperature opposite to that which prevails in the rest of Europe. When the winter is rigorous in the temperate climates, it is mild in Greenland, and very severe in this northern region, when it is moderate in our countries. At the end of the year 1739, the winter was so mild in the bay of Disko, that the geese, in the month of January, passed from the temperate to the frozen zone in quest of warmer air; and that, in 1740, no ice was seen at Disko in the month of March; while, in Europe, the ice prevailed, without interruption, from October to May.

‘ In winter 1763, which was extremely cold over all Europe, the cold was so little felt in Greenland, that some summers have been less mild.

We are assured by voyagers, that, in the seas adjacent to Greenland, there are very high mountains of floating ice, and others which resemble rafts of two hundred fathoms in length, by sixty or eighty in breadth. But these boards of ice, which form immense plains upon the sea, are seldom above nine or twelve feet thick. They seem to be formed immediately on the surface when the cold is greatest. But the floating and very high masses come from the land, *i. e.* from the environs of mountains and coasts, from which they have been detached and carried down to the sea by the rivers. These masses of ice bring along with them great quantities of wood, which are afterwards thrown by the sea upon the eastern coasts of Greenland. This wood, it appears, neither comes from Labrador nor Norway; because the north-east winds, which are very violent in these countries, would push back the trees, and the currents which run to the south of Davis's strait, and Hudson's bay, would stop all that might come from America to the coasts of Greenland.

The sea begins to carry boards of ice to Spitzbergen in the months of April and May. A great number come from Davis's strait, part of them from Nova Zembla, and the greatest number from the east coast of Greenland, being transported from east to west according to the general movement of the ocean.

The following facts and notices are to be found in the voyage of Captain Phipps. ‘ The idea of a passage to the East Indies by the North Pole was suggested as early as the year 1527, by Robert Thorne, merchant of Bristol.’ No voyage, however, appears to have been undertaken to explore the circumpolar seas, till the year 1607, when ‘ Henry Hudson was sent forth, at the charge of certain worshipful merchants of London, to discover a passage by the North Pole, to Japan and China. . . . . And this I can assure at this present, that between seventy-eight degrees and a half, and eighty-two degrees, by this way there is no passage.

‘ In 1609, a voyage was set forth by the Right Worshipful Sir Thomas Smith to the south part of Spitzbergen; and, when near Foreland, he sent his mate ashore; and speaking of the account he gave at his return, says, Moreover, I was certified that all the ponds and lakes were unfrozen, they being fresh water; which putteth me in hope of a mild summer here, after so sharp a beginning as I have had; and my opinion is such, and I assure myself it is so, that a passage may be as soon attained this way by the Pole, as any unknown way whatsoever, by reason the sun doth give a great heat in this climate, and the ice (I mean that freezeth here) is nothing so huge as I have seen in seventy-three degrees.’ Several other voyagers have attempted to discover this passage, but without success.

On the fifth of July, Captain Phipps saw great quantities of floating ice about the 79° 34′ of latitude. The weather was foggy. The next day he continued his course as far as the 79° 59′ 39″ between Spitzbergen and the ice. On the 7th, he proceeded through the floating masses of ice in quest of an open passage to the north by which he might gain an open sea. But the ice to the north-north-west formed one continued mass; and at 80° 36′ the sea was entirely frozen; so that all the attempts of Captain Phipps to discover a passage proved abortive. ‘ On the 12th of September, Dr. Irvine tried the temperature of the sea in a state of great agitation, and found it considerably warmer than that of the atmosphere. This observation is the more interesting, as it agrees with a passage in Plutarch's Natural Questions, not (I believe) before taken notice of, or confirmed by experiment, in which he remarks, that the sea becomes warmer by being agitated in waves. These gales are as common in the spring as in the autumn; there is every reason to suppose, therefore, that at an early season we should have met with the same bad weather in going out as we did on our return.’ And as Captain Phipps departed from England in the end of May, he certainly took the season most favourable to his expedition. ‘ There was also most probability, if ever navigation should be practicable to the Pole, of finding the sea open to the northward after the solstice; the sun having then exerted the full influence of his rays, though there was enough of the summer still remaining for the purpose of exploring the seas to the northward and westward of Spitzbergen.’

I agree entirely with this able navigator; and I suspect that the expedition to the Pole cannot be renewed with success, and that we can never reach beyond the 82d or 83d degree. We are assured, that a vessel from Whitby, in the year 1774, penetrated as far as the 80th degree, without seeing ice sufficient to prevent sailing still farther. A Captain Robinson is likewise quoted, from whose journal it appears, that in 1773 he arrived at the 81° 30′. Lastly, a Dutch ship of war, sent to protect the whale-fishers, is said to have advanced about fifty years ago as far as the 88th degree. Dr. Campbell, it is added, received this intelligence from a Dr. Daillie, who was in the vessel, and practised physic in London in the year 1745. This is probably the same navigator whom I formerly quoted under the name of Captain Mouton. But I am extremely suspicious of the fact; and I am persuaded, that we shall in vain attempt to reach beyond the 82d or 83d degree, and that if a passage by the north is practicable it can only be by the way of Hudson's bay.

On this subject the following passage of the learned and ingenious author of the history of the Two Indies merits attention: 'Hudson's bay always has been, and is still looked upon as the nearest road from Europe to the East Indies, and to the richest parts of Asia.

'Cabot was the first who entertained an idea of a north-west passage to the South seas; but his discoveries ended at Newfoundland. After him followed a crowd of English navigators, many of whom had the honour of giving their names to savage coasts which no mortal had ever visited before. These bold and memorable expeditions were more striking than really useful. The most fortunate of them did not furnish a single idea relative to the object of pursuit. The Dutch, less frequent in their attempts, and who pursued them with less ardour, were of course not more successful, and the whole began to be treated as a chimera, when the discovery of Hudson's bay rekindled all the hopes that were nearly extinguished.

'From this time the attempts were renewed with fresh ardour. Those that had been made before in vain by the mother country, whose attention was engrossed by her own intestine commotions, were pursued by New England, whose situation was favourable to the enterprise. Still, however, for some time there were more voyages undertaken than discoveries made. The nation was a long time kept in suspense by the contradictory accounts received from the adventurers. While some maintained the possibility, some the probability, and others asserted the certainty of the passage; the accounts they gave, instead of clearing up the point, involved it in still greater darkness. Indeed, these accounts are so full of obscurity and confusion, they are silent upon so many important circumstances, and they display such visible marks of ignorance and want of veracity, that however impatient we may be of determining the question, it is impossible to build any thing like a solid judgment upon testimonies so suspicious. At length the famous expedition of 1746 threw some kind of light upon a point which had remained enveloped in darkness for two centuries past. But upon what grounds have the later navigators entertained better hopes? What are the experiments on which they found their conjectures?

'Let us proceed to give an account of their arguments. There are three facts in natural history which henceforward must be taken for granted. The first is, that the tides come from the ocean, and that they extend more or less into the other seas, in proportion as their channels communicate with the great reservoir by larger or smaller openings; from whence it follows that this periodical motion is scarcely perceptible in the Mediterranean, in the Baltic, and other gulfs of the same nature. A second matter of fact is, that the tides are much later and much weaker in places more remote from the ocean than in those which are nearer to it. The third fact is, that violent winds, which blow in a direction with the tides, make them rise above their ordinary boundaries, and that those which blow in a contrary direction retard their motion, at the same time that they diminish their swell.

'From these principles it is most certain that if Hudson's bay were no more than a gulf inclosed between two continents, and had no communication but with the Atlantic, the tides in it would be very inconsiderable; they would be weaker in proportion as they were further removed from the source, and would be less strong wherever they ran in a contrary direction to the wind. But it is proved by observations made with the greatest skill and precision, that the tides are very high throughout the whole bay. It is certain that they are higher towards the bottom of the bay than even in the strait itself, or at least in the neighbourhood of it. It is proved that even this height increases whenever the wind blows from a corner opposite to the strait; it is therefore certain, that Hudson's bay has a communication with the ocean beside that which has been already found out.

'Those who have endeavoured to explain these very striking facts, by supposing a communication of Hudson's with Baffin's bay, or with Davis's straits, are evidently mistaken. They would not scruple to reject this opinion, for which indeed there is no real foundation, if they only considered that the tides are much lower in Davis's straits and in Baffin's bay than in Hudson's.

But if the tides in Hudson's bay can come neither from the Atlantic ocean, nor from any other northern sea, in which they are constantly much weaker, it follows that they must have their origin in the South Sea. And this is still further apparent from another leading fact, which is, that the highest tides ever observed upon these coasts are always occasioned by the north-west winds, which blow directly against the mouth of the strait.

'Having thus determined, as much as the nature of the subject will permit, the existence of this passage so long and so vainly wished for, the next point is to find out in what part of the bay it is to be expected. From considering every circumstance, we are induced to think that the attempts which have been hitherto made without either choice or method, ought to be directed towards Welcome bay, on the western coast. First, the bottom of the sea is to be seen there at the depth of about eleven fathom, which is an evident sign that the water comes from some ocean, as such a transparency could not exist in waters discharged from rivers, or in melted snow or rain. Secondly, the currents keep this place always free from ice, while all the rest of the bay is covered with it; and their violence cannot be accounted for but by supposing them to come from some western sea. Lastly, the whales, who towards the latter end of autumn always go in search of the warmest climates, are found in great abundance in these parts towards the end of summer, which would seem to indicate that there is an outlet for them from thence to the south seas, not to the northern ocean.

'It is probable that the passage is very short. All the rivers that empty themselves on the western coast of Hudson's bay are small and slow, which seems to prove that they do not come from any distance; and that consequently the lands which separate the two seas are of a small extent. This argument is strengthened by the height and regularity of the tides. Wherever there is no other difference between the times of the ebb and flow, but that which is occasioned by the retarded progression of the moon in her return to the meridian, it is a certain sign that the ocean from whence those tides come is very near. If the passage is short, and not very far to the north, as every thing seems to promise, we may also presume that it is not very difficult. The rapidity of the currents observable in these latitudes, which prevents any flakes of ice from continuing there, cannot but give some weight to this conjecture.'

I believe, with this excellent writer, that if a practicable passage exists, it must be at the bottom of Hudson's bay, and that all attempts by Baffin's bay will be fruitless, because the climate is too cold, and its coasts are always frozen, especially towards the north. But the existence of this passage is rendered still more doubtful by the lands discovered in 1741 by Bering and Tchirikow, under the same latitude with Hudson's bay; for these lands seem to form a part of the great Continent of America, which appears to stretch under the same latitude as far as the Polar circle. Of course the passage into the south sea can only be found about the 55th degree of north latitude.

IV.

Of the Caspian Sea.

To what was advanced in order to prove that the Caspian sea is only a lake, and never had any communication with the ocean, I have to add the answers I received from the Academy of Petersburg to some queries I transmitted them concerning this sea.

'Augusto 1748, October 5, &c.—Cancellaria Academiæ Scientiarum mandavit, ut Astrachanensis Gubernii Cancellaria responderet ad sequentia. 1. Suntne vortices in mari Caspico necne? 2. Quæ genera piscium illud inhabitant? Quomodo appellantur? Et an marini tantum aut et fluviatiles ibidem reperiantur? 3. Qualia genera concharum? Quæ species ostrearum et cancrorum occurrunt? 4. Quæ genera marinarum avium in ipso mari aut circa illud versantur? ad quæ Astrachensis Cancellaria d. 13 Mart. 1749, sequentibus respondit.

'Ad. 1. in mari Caspico vortices occurrunt nusquam; hinc est quod nec in mappis marinis extant, nec ab ullo officialium rei navalis visi esse perhibentur.

'Ad. 2. pisces Caspium mare inhabitant; Acipenseres, Sturioli, Gmel, Siruli Cyprini clavati, Bramæ, Percæ, Cyprini ventre acuto, ignoti alibi pisces, tincæ, salmones, qui ut e mari fluvios intrare, ita et in mare e fluviis remeare solent;

'Ad. 3. conchæ in littoribus maris obviæ quidem sunt, sed parvæ, candidæ, aut ex unâ parte rubræ. Cancri ad littora observantur magnitudine fluviatilibus similes; ostreæ autem et capita Medusæ visa sunt nusquam;

'Ad. 4. aves marinæ quæ circa mare Caspium versantur sunt anseres vulgares et rubri, pelicani, cygni, anates rubræ et nigricantes, aquilæ, corvi aquatici, grues, plateæ, ardeæ albæ, cinereæ, et nigricantes, ciconiæ albæ gruibus similes, Karawaiki (ignotum avis nomen) larorum variæ species, sturni nigri et lateribus albis instar picarum, physiani, anseres parvi nigricantes, Tudaki (ignotum avis nomen) albo colore præditi.'

These facts, which are both accurate and authentic, confirm my position, that the Caspian sea has no subterraneous communication with the ocean. They prove farther, that this sea never formed a part of the ocean; for it contains neither oysters nor any other sea-shells, but such species only as are found in rivers. We are therefore warranted to conclude, that this sea is nothing but a great lake formed by the waters of rivers, since we find in it the same fishes and the same shells which inhabit the rivers, and none of those which people the ocean or the Mediterranean.

V.

Of the Salt Lakes of Asia.

In the country of the Ufian Tartars, so called because they inhabit the banks of the river Uf, there are, M. Pallas remarks, lakes, the waters of which were formerly fresh, and are now salt. He makes the same remark concerning a lake near Miacs.

One of the lakes most famous for the quantity of salt extracted from it is that near the banks of the river Isel, called Soratschya. The salt of it in general is bitter, and employed by the physicians as a good purgative. Two ounces of this salt make a very strong dose. Near Kurtenegsch the shoals are covered with a bitter salt, which rises, like a field of snow, to the height of two inches. The lake Korjackof furnishes annually three hundred thousand cubic feet of salt. Lake Jennu likewise furnishes a great quantity.

[The cubic foot weighs thirty-five pounds each of sixteen ounces.]

In the voyages performed under the auspices of the Academy of Petersburg, mention is made of the salt lake of Jamuscha in Siberia. This lake, which is nearly round, is only about nine leagues in circumference. Its margins are covered with salt, and the bottom is clothed with crystals of salt. The water is extremely salt; and when the sun shines, it appears reddish like the sky in a fine morning. The salt is as white as snow, and forms itself into cubic crystals. The quantity of it is so immense that a number of vessels may in a short time be loaded with it; and after it has been removed, it is again replaced in five or six days. It is sufficient to remark, that it supplies the provinces of Tobolski and Jeniscik, and that this lake could supply fifty provinces of similar extent. The commerce of this, as well as of all other salt, is reserved in the hands of the crown. This salt is exceedingly good. It surpasses all others in whiteness, and none is more proper for curing meat. In the south of Asia there are likewise salt lakes, one near the Euphrates, and another in the neighbourhood of Barra. There are others, it is said, near Haleb, and at Larneca in the island of Cyprus. This last borders upon the sea. The salt valley of Barra, being at no great distance from the Euphrates, might be worked if its waters were made to run into this river, and if the earth was good: but at present this earth yields a good salt for the kitchen, and even in such quantity that the Bengal vessels, when returning in ballast, take in loadings of this salt.

ADDITIONS *and Corrections to the Article, Of Inequalities at the bottom of the Sea, and of Currents,* Vol. I. p. 90.

I.

Of the Nature and Quality of the Soil at the bottom of the Sea.

M. L'ABBE DICQUEMARE, a learned natural philosopher, has made some observations on this subject, which seem to accord with what I have advanced in my Theory of the Earth.

'Conversations with pilates of all languages, the perusal of charts and soundings both ancient and modern, the examination of such bodies as attach themselves to the plummet, the inspection of coasts, banks, and of the strata which compose the interior parts of the earth, to a depth nearly equal to the length of our common plumb lines, some reflections which are most analogous to this subject arising from physics, cosmography, and natural history, have made me suspect, nay, have even convinced me, says M. l'Abbé Dicquemare, 'that in some places 'there must be two different bottoms, the one often 'covering the other at intervals: the ancient and per'manent, which may be called the general bottom, and 'the other accidental or particular. The first, which 'ought to form the basis of a general picture, is the soil 'of the basin that contains the sea. It is composed of 'the same strata which we every where find in the 'bowels of the earth, such as marl, stone, clay, sand, 'shells, all disposed horizontally, and of an equal thick'ness through a great extent. Here we find a bottom 'of marl, there a bottom of clay, sand, or rock. Lastly, 'the number of general bottoms discoverable by sound'ing exceeds not six or seven species. The most exten'sive and thickest of these strata, being uncovered or 'cut perpendicularly, form great spaces in the sea, 'where we ought to recognise the general bottom, in'dependent of such foreign substances as may be depo'sited by currents or other causes. There are other 'permanent bottoms which we have not hitherto men'tioned; these are those immense masses of madrepores 'and corals which often cover a bottom of rock, and 'those enormous and extended banks of shells, which a 'rapid multiplication or other causes have accumulated, 'and which occur in different places, as it were in

‘ colonies. One species occupies a certain extent; the succeeding space is occupied by another species, in the same manner as has been remarked with regard to fossil shells, in a great part of Europe, and perhaps every where else. It is by observations on the interior parts of the earth, and on such places as the sea leaves uncovered, where we always see particular species reigning over certain districts, that we have been enabled to form some idea of the prodigious number of individuals, and of the thickness of the banks at the bottom of the sea, of which we can only know the surface by our soundings.

‘ The accidental or particular bottom is composed of immense numbers of the prickles of the sea urchin; of fragments of shells, sometimes corrupted, of crustaceous animals; of madrepores; of sea plants; of pyrites; of granites rounded by friction; of pieces of mother of pearl; of mica; perhaps of talc, to which different names are given according to their appearances; of entire shells, but in small quantity, and seemingly dispersed through no great extent; of small flints, some crystals, coloured sands, a light slime, &c. All these bodies, disseminated by the currents, the agitation of the waters, and partly proceeding from the rivers, from sinking of the hills or high beaches, and other accidental causes, seldom perfectly cover the general bottom, which appears every instant, when we sound often in the same regions. I remarked, that during near a century, a great part of the general bottoms of the gulf of Gascony and la Mancha have suffered little or no change, which supports my opinion concerning the two bottoms.’

II.

Of Currents in the Ocean.

To the enumeration of currents we shall add the famous current of Mosckoe, Mosche, or Male, on the coast of Norway, of which a learned Swede has given the following description.

‘ This current, which took its name from the rock of Moschensicle, situate between the two islands of Tofode and Woeroen, extends four miles from north to south.

‘ It is extremely rapid, especially between the rock of Mosche and the point of Lofoede. But in proportion as it approaches the two isles of Woeroen and Roest, its rapidity diminishes. It finishes its course from north to south in six hours, and from south to north in an equal time.

‘ This current is so rapid that it produces a number of small eddies, which the Norwegians call *gargamer*.

‘ Instead of following the course of the tides, it observes an opposite direction. When the waters of the ocean rise, they proceed from south to north, but the current then runs from north to south. When the sea retires it goes from north to south, but the current then runs from south to north.

‘ It is remarkable, that both in going and returning it does not describe a straight line, like other currents found in some straits, where the waters of the sea rise and fall; but it moves in a circular direction.

‘ When the waters of the sea have risen one half, those of the current run to the south south-east. In proportion as the sea rises the current turns towards the south; from thence it turns towards the south-west, and from the south-west to the west.

‘ When the tide is full the current goes toward the north-west, and then toward the north. About the middle of the reflux the current recommences its course, after having been suspended during some seconds.

‘ The principal phenomenon is its return by the west from the south south-east toward the north. If it did not come back by the same road it would be difficult and almost impossible to sail from the point of Lofoede to the two great islands of Woeroen and Rouest. There are two parishes, which would necessarily be uninhabited, if the current observed not the course I have described. But as it actually observes this course, those who pass from the point of Lofoede to the two islands wait till the tide has risen one half, because the direction of the current is then to the west. When they want to return from these islands to the point of Lofoede, they wait till the tide be half ebb; because the course of the current is then toward the Continent. This circumstance renders the passage very easy. Now there is no current without a declivity; and here the water rises on one side and descends by the other.

‘ To be convinced of this truth we have only to consider that there is a small tongue of land in Norway which extends sixteen miles into the sea, from the point of Lofoede, which inclines more to the west, as far as that of Loddinge, which inclines more to the east. This tongue of land is surrounded by the sea; and, whether during the flux or reflux, the water is always stopt there; because it can have no issue but through six small straits or passages which divide the tongue of land into an equal number of portions. Some of these exceed not half a quarter of a mile in breadth, and sometimes not half so much. Hence they can contain only a small quantity of water. Of course when the sea rises a great part of the water coming to the north is stopt to the south of this tongue of land. The waters are, therefore, much more elevated toward the south than toward the north. When the sea retires, and goes toward the south, a great part of the water, 'in the same manner, is arrested to the north of this 'tongue of land, and consequently is much higher to'wards the north than towards the south.

'The waters thus interrupted sometimes at the north 'and sometimes at the south, can find an issue only 'between the point of Lofoede and the island of Woe'roen, and between this island and that of Rouest.

'The declivity of the waters, when they descend, 'produces the rapidity of the current; and for the same 'reason this rapidity is greatest toward the point of Lo'foede. As this point is nearest the place where the 'waters are stopt, the rapidity there is likewise greatest; 'and in proportion as the waters of the current extend 'toward the islands of Wocroen and Rouest their celerity 'decreases.

'It is now easy to conceive why the current is always 'diametrically opposite to the motion of the sea. No'thing opposes the common movement of the waters, 'whether they rise or fall. But the waters which are 'stopt above the point of Lofoede can neither move in a 'straight line, nor beyond this point, while the sea has 'not descended lower, and has not in retiring carried off 'the waters, which those that are stopt above the point 'of Lofoede ought to replace.

'At the commencement of the flux and reflux the 'waters of the sea cannot turn back those of the cur'rent; but when they have risen or fallen one half, they 'are then enabled to change the direction of the cur'rent. As it cannot then turn toward the east, because 'the water is always stable near the point of Lofoede, 'as formerly remarked, it must necessarily proceed 'toward the west, where the water is lower.' This explication seems to be conformable to the true principles of the theory of running waters.

We must still add the description of the famous current of Scylla and Charybdis, near the island of Sicily, concerning which Mr. Brydone has lately made some observations tending to prove that the violence and rapidity of its movements are much diminished.

'It was almost a dead calm, our ship scarce moving 'half a mile in an hour, so that we had time to get a 'complete view of the famous rock of Scylla, on the 'Calabrian side, Cape Pylorus on the Sicilian, and the 'celebrated Straits of the Faro that runs between them. 'Whilst we were still some miles distant from the entry 'of the Straits, we heard the roaring of the current, like 'the noise of some large impetuous river confined 'between narrow banks. This increased in proportion 'as we advanced, till we saw the water in many places 'raised to a considerable height, and forming large eddies 'or whirlpools. The sea in every other place was as 'smooth as glass. Our old pilot told us that he had often 'seen ships caught in these eddies, and whirled about 'with great rapidity, without obeying the helm in the 'smallest degree. When the weather is calm there is 'little danger; but when the waves meet with this 'violent current it makes a dreadful sea. He says, there 'were five ships wrecked in this spot last winter. We 'observed that the current set exactly for the rock of 'Scylla, and would infallibly have carried any thing 'thrown into it against that point; so that it was not 'without reason that the ancients have painted it as an 'object of such terror. It is about a mile from the entry 'of the Faro, and forms a small promontory, which 'runs a little out to sea, and meets the whole force of 'the waters as they come out of the narrowest part of 'the Straits. The head of this promontory is the famous 'Scylla. It must be owned that it does not altogether 'come up to the formidable description that Homer 'gives of it; the reading of which (like that of Shake'peare's Cliff) almost makes one's head giddy. Neither 'is the passage so wonderous narrow and difficult as he 'makes it. Indeed it is probable that the breadth of it 'is greatly increased since his time by the violent impe'tuosity of the current. And this violence too must 'always have diminished in proportion as the breadth of 'the channel increased. The rock is near 200 feet high. 'There is a kind of castle or fort built on its summit; and 'the town of Scylla, or Sciglio, containing three or four 'hundred inhabitants, stands on its south side, and gives 'the title of prince to a Calabrese family. We lay just 'opposite to Cape Pylorus, where the light-house is 'now built. The mouth of the Straits, betwixt the 'promontories of Pylorus in Sicily, and the Coda de 'Volpe in Calabria, appears scarcely to be a mile. But 'the channel enlarges to four miles in breadth near 'Messina, which is twelve miles from the mouth of the 'Straits. The celebrated gulf or whirlpool of Charybdis 'lies near to the entry of the harbour of Messina, and 'often occasions such an intestine and irregular motion 'in the water, that the helm loses most of its power, 'and ships have great difficulty to get in, even with the 'fairest wind that can blow. Aristotle gives a long and 'formidable description of it in his 125th chapter, De 'Admirandis, which I find translated in an old Sicilian 'book I have got here. It begins, "Adeo profundum, 'horridumque spectaculum," &c. but it is too long to 'transcribe. It is likewise described by Homer, 12th 'of the Odyssey; Virgil, 3d Æneid; Lucretius, Ovid, 'Sallust, Seneca, as also by many of the old Italian and 'Sicilian poets, who all speak of it in terms of horror; 'and represent it as an object that inspired terror, even 'when looked on at a distance. It certainly is not now 'so formidable; and very probably the violence of this 'motion, continued for so many ages, has by degrees 'worn smooth the rugged rocks and jutting shelves that 'may have intercepted and confined the waters. The 'breadth of the Straits too in this place, I make no 'doubt, is considerably enlarged. Indeed, from the 'nature of things it must be so; the perpetual friction 'occasioned by the current must wear away the bank on 'each side, and enlarge the bed of the water.

'The vessels in this passage were obliged to go as 'near as possible to the coast of Calabria, in order to 'avoid the suction occasioned by the whirling of the 'waters in this vortex; by which means, when they 'came to the narrowest and most rapid part of the 'Straits, betwixt Cape Pylorus and Scylla, they were in 'great danger of being carried upon that rock. From 'whence the proverb, still applied to those who in 'attempting to avoid one evil fall into another.

"Incidit in Scyllam, cupiens vitare Charybdim."

'Here another light-house is placed to warn sailors of 'their approach to Charybdis, as that other on Cape 'Pylorus is intended to give them notice of Scylla.'

Additions *to the Article, Of Regular Winds,* Vol. I. p. 96.

I.

Of Reflected Wind.

I SHALL here mention a fact which seems to have escaped the observation of natural philosophers, though every man is in a condition to convince himself of its truth. The fact is that the reflected wind is more violent than the direct, and still more so in proportion to the nearness of the obstacle by which it is reflected. I have often made the experiment by approaching a tower, of near a hundred feet high, and situated at the north of my garden at Montbard. When a strong south wind blows, we are violently pushed back, at the distance of thirty paces: after which there is an interval for five or six paces, where the violence of the reflected wind ceases, and seems to be in equilibrium with the direct. The nearer we approach, the strength of the reflected wind augments, and pushes us back with much greater force than the direct wind pushes us forward. The cause of this general effect, which may be perceived opposite to any high buildings, precipices, &c. it is not difficult to discover. The air in the direct wind acts only by its celerity and its common volume; but this volume or mass is considerably augmented by the compression it receives from the obstacle by which it is reflected; and as the quantity of every motion consists of the celerity multiplied by the volume, this quantity is much greater after being compressed than before. It is a volume of common air which acts in the first case, and a volume of air of double or triple the density which acts in the second.

II.

Of the State of the Air at the top of high Mountains.

It has been proved by a thousand experiments that the higher we rise above the level of the sea or plains the column of mercury in the barometer sinks the lower; and consequently that the weight of a column of air diminishes in proportion to the elevation of the place; and as air is an elastic and compressible fluid, philosophers have unanimously concluded from these experiments, that the air is much more dense and compressed in the plains than on the tops of mountains. For example, if the barometer, which stands at 27 inches in the plain, falls on the top of a mountain to 18, a difference of one third of the whole weight of the column of air, we say, that the compression of this element being always proportioned to the incumbent weight, the air at the top of the mountain is of course one third less dense than that in the plain, because it is compressed by a weight one third less. But strong reasons concur in making me suspect the truth of this conclusion, which has hitherto been regarded as natural and perfectly legitimate.

Let us for a moment abstract this compressibility of the air, which several causes may augment or diminish, destroy or compensate: let us suppose the air to be every where equally dense; if its thickness exceeded not three leagues, it is certain that in mounting one league the barometer, being loaded with one third less weight, would descend from 27 to 18 inches. Now the air, though compressible, appears to me to be equally dense at all heights; and this opinion I shall support by the following facts and reasonings.

1. The winds are equally strong, and equally violent at the tops of the highest mountains as in the lowest valleys. With regard to this fact all observers are agreed. Now if the density of the air were one third less, the action of the wind would necessarily be one third weaker, and all the winds at the height of a league would be only zephyrs, which is absolutely contradicted by uniform experience.

2. Eagles and several other birds not only fly to the tops of the highest mountains, but rise to great heights above them. Now I ask if these animals could either fly, or even support themselves, in a fluid one third less dense than common air, and if the weight of their

bodies, notwithstanding all their efforts, would not oblige them to sink lower?

3. All observers who have climbed to the tops of the highest mountains agree that they respire as freely as in any other situation, and that the only inconveniency they feel arises from the cold, which augments in proportion to the elevation. Now if the air was one third less dense at the tops of mountains, the respiration of man, and of birds, which mount still higher, would not only be injured, but stopped, as actually happens to animals in an air pump when one fourth or one third of the air contained in the receiver is exhausted.

4. As cold condenses as much as heat rarefies the air, and as, in proportion to the elevation of mountains, the cold increases, does it not follow, that the degrees of condensation of the air correspond to the degrees of cold? This condensation may equal, and even surpass that of the air in plains, where the heat escaping from the internal parts of the earth is much greater than at the tops of mountains, which are the most advanced and coldest points on the surface of the globe. Hence this condensation of the air by cold in high regions of the atmosphere should compensate the diminution of density produced by a decrease of the incumbent weight; and of course the air should be equally dense on the cold summits of mountains as in the plains. I am even led to think, that the air is more dense on the tops of mountains, because there the winds seem to be more violent, and the birds which soar above the highest summits appear to support themselves in the air with more ease in proportion to the height they rise.

I may therefore conclude, that the free air is nearly of equal density at all heights, and that the atmosphere extends not so high as has been determined, by considering the air as an elastic mass compressed by an incumbent weight. Thus the total thickness of the atmosphere may not exceed three leagues, instead of from fifteen to twenty, as has been conjectured by philosophers.

[Alhazen, from the duration of the twilights, pretended that the height of the atmosphere is 44,331 fathoms. Kepler, upon the same principle, makes it 41,110 fathoms.

M. de la Hire, when treating of the horizontal refraction of 32 minutes, fixes the mean height of the atmosphere at 34,585 fathoms.

M. Mariotte, from his experiments on the compressibility of air, makes the height of the atmosphere 30,000 fathoms.

However, comprehending under the atmosphere that part of the air only in which refractions take place, M. Bouguer ascertains the height not to be above 5158 fathoms, i. e. two and a half or three leagues; and I believe that this result is more certain and better founded than any of the others.]

The first stratum of the atmosphere is filled with vapours exhaled from the surface of the globe, both by its own heat and that of the sun. In this stratum, which extends to the height of the clouds, the heat arising from exhalations produces and supports a rarefaction that forms an equipoise to the superior air; so that the lower stratum of the atmosphere is not so dense as it ought to be in proportion to the pressure it receives. But at the height where this rarefaction ceases the air undergoes all that condensation which is produced by the cold of this region, where the heat arising from the earth is much diminished; and this condensation appears to be even greater than that which might be produced by the weight of the superior strata in the inferior regions, which are supported by rarefaction. This idea is strengthened by another phenomenon, which is the condensation and suspension of the clouds in that elevated region where they are formed and supported. Beyond this middle region, where the cold and condensation commence, the vapours rise, but cease to be visible, except when a part of a cold stratum seems to be pushed back toward the surface of the earth, and when the heat escaping from the earth being for some time extinguished by rains, the vapours then collect and thicken around us in the form of mists and fogs. Without these circumstances the vapours never become visible till they arrive at that region where the cold condenses them into clouds, and stops their further ascension: their gravity, which augments in proportion as they become more dense, fixes them in an equipoise which they cannot surmount. We perceive that the clouds are generally higher in summer, and still higher in warm climates. It is in this season and in these climates that the stratum formed by evaporation from the earth rises highest. On the contrary, in the frozen regions near the pole, where the evaporation produced by the heat of the globe is much less, the stratum of dense air seems to touch the surface, and there to retain the clouds, which never rise higher, but surround these gloomy regions with perpetual fogs.

III.

Of some Winds which have a regular Variation.

There are certain climates and particular countries where the winds vary regularly; some at the end of six months, others in a few weeks, others from morning to night, and from night to morning. In Vol. I. p. 95, I remarked, 'That at St. Domingo there are two different winds which rise regularly every day; the one, 'which is from the sea, comes from the east, and begins 'at 10 o'clock before noon; the other, which is a land-'wind, rises at 6 or 7 in the evening, and continues the 'whole night.' M. Fresnaye writes me, that my information has not been exact. 'The two regular winds,' he remarks, 'which blow at St. Domingo are both from 'the sea, and blow, the one in the morning from the 'east, and the other in the evening from the west, which 'is only the same wind returned. It is evidently occa'sioned by the sun; for every man perceives that be'tween one and two o'clock after noon a transient gust 'arises. When the sun declines, by rarefying the air on 'the west, it drives to the east the clouds which the 'morning wind had confined toward the opposite quarter. 'These returned clouds, from April or May till toward 'autumn, produce in the district of Port-au-Prince the 'regular rains which constantly proceed from the east. 'There is not a single inhabitant who does not predict 'the evening rain between six and nine o'clock, when, 'according to their mode of expression, *the broken cloud* '*has been sent back.* The west wind continues not 'during the whole night. It fails regularly toward the 'evening; and when it ceases, the clouds pushed from 'the east are enabled to fall in the form of rain, as soon 'as their weight exceeds that of an equal column of air. 'The wind which prevails in the night is a land-wind, 'which proceeds neither from the east nor the west, but 'follows the projections of the coast. At Port-au-Prince 'the south wind, because it traverses the course of the 'river, is intolerably cold during the months of January 'and February.'

IV.

Of Lavanges, or great Masses of Snow and Ice rolling down from high Mountains.

In high mountains there are winds produced by accidental causes, and particularly by what the French call *lavanges.* In the environs of the Alpine glacieres, several species of *lavanges* are distinguishable; some of them are called *windy lavanges,* because they produce a great wind. They are formed when a new fall of snow has been put in motion, either from melting below by the interior heat of the earth, or by the agitation of the air. The snow then forms itself into balls, and in rolling accumulates, falls in vast masses into the valleys, and produces a great agitation in the air; because the snow runs with rapidity, and in immense volumes, and the winds occasioned by the motion of these masses are so impetuous, that they overturn every thing, even the largest pines, that oppose their passage. These lavanges cover the whole territory over which they extend with a very fine snow; and this powdered snow rises in the air at the caprice of the winds, *i. e.* without any fixed direction, which is extremely dangerous to people in the fields; because they know not to what side to run in order to protect themselves; for in a few seconds they find themselves surrounded, and often completely buried with the snow.

Another species of *lavanges,* still more dangerous than the first, is called by the country people Schlaglawen, *i. e. dashing or striking lavanges.* They proceed not with such rapidity as the first kind; but they overturn every thing in their way, and carry along with them great quantities of earth, stones, flints, and even entire trees; so that their passage from the mountain to the valley is a vast track of destruction and ruin. As they proceed with less rapidity than the *lavanges* composed of pure snow, they are more easily avoided. Their approach is announced at a distance; for they shake the mountains and the valleys by their motion and weight, and produce a noise equal to that of thunder.

These tremendous effects may proceed from very slight causes: a small quantity of snow falling from a tree or a rock, the sound of bells, or the shock of a cannon or musket, provided they detach some portions of snow from the summit, which form into balls, and increase in magnitude as they descend, will accumulate into a mass as large as a small mountain before they arrive at the valley.

The inhabitants of countries subject to *lavanges* have invented several precautions to prevent their destructive effects. They place their buildings opposite to small eminences, which may break the force of the *lavanges.* They likewise make plantations of wood before their habitations. At Mount St. Godard there is a forest in a triangular form, the acute angle of which is directed towards the mountain, and seems to have been planted with a view to turn off the *lavanges* from the village of Urseren and the buildings situated at the foot of the mountain; and every person is forbid, under the severest penalties, to injure the forest, which may be regarded as the safeguard of the village. With the same intention there are in many places walls erected with their acute angles turned toward the mountain. A wall of this kind may be seen at Davis, in the country of the Grisons, as also near the baths of Leuk or Louache, in Valais. In the same country of the Grisons, and other places, there are, in the passages through the mountains, vaults at convenient distances, cut out of the rock on the side of the highway, which serve passengers as places of refuge against the lavanges.

ADDITIONS *to the Article, Of Irregular Winds, Water-spouts*, &c. Vol. I. p. 98.

I.

Of the Violence of the South Winds in some Northern Countries.

THE Russian voyagers have remarked, that, in the entry to the territory of Milim, there is, on the left of the river Lena, a great plain entirely covered with overturned trees, and that all these trees lie in a direction from south to north for an extent of several leagues; so that the whole district, formerly covered with trees, is now strewed with dead trunks in the above direction from south to north. This effect of the south winds has likewise been observed in other northern regions.

In Greenland, and particularly in the autumn, the winds are so impetuous, that the houses are often shaken to pieces, and the boats and tents carried up into the air. The Greenlanders even assure us, that, when they go out to secure their boats, they are obliged to creep on their bellies, lest they should become the sport of the winds. The most violent tempests come from the south, turn to the north, and then terminate in a calm. It is on these occasions that the ice in the bays is raised from its bed, and dispersed in small portions over the ocean.

II.

Of Water-Spouts.

M. de la Nux, whom I have often quoted, and who lived forty years in the isle of Bourbon, has had an opportunity of seeing a great number of water-spouts, and he has communicated to me his observations, of which the following is an abridgement.

The water-spouts observed by M. de la Nux were formed, 1. In calm days, and in those intervals when the wind passes from the south to the north; though he saw one, which was formed previous to this passage of the wind from one quarter to another, and even in the current of a north wind, *i. e.* a pretty long time before this wind had ceased: the cloud from which this water-spout depended, and to which it was attached, was still violently driven to the south. The sun, at the same time, was seen behind the cloud to the south. It happened on the 6th day of January, about eleven o'clock before noon.

2. These water-spouts are formed during the day in detached clouds, apparently very thick, much longer than broad, and well defined below in the direction of the horizon: the under part of these clouds is always very black.

3. All these water-spouts at first appear under the form of inverted cones, whose bases are more or less extensive.

4. Several of those water-spouts that appear under the figure of inverted cones, are sometimes attached to the same cloud; some are never entirely completed; some are dissipated at a small distance from the cloud; and others descend apparently very near to the surface of the sea, under the form of a long flat cone, which is narrow and pointed at the bottom. In the centre of this cone, and through its whole length, there is a whitish transparent canal, about one third of the diameter of the cone, the two sides of which were very black, especially on their first appearance.

These water-spouts were observed from a point in the isle of Bourbon elevated 150 fathoms above the level of the sea, and they were generally three, four, or five leagues from the place of observation, which was the house of M. de la Nux.

The following is a more particular description of these water-spouts.

When the end of the shaft, or top of the cone, which is then very sharp pointed, has descended about a fourth of the distance of the cloud from the sea, we begin to perceive on its surface, which is commonly calm and of a transparent whiteness, a small black circle, which is produced by the agitation and whirling of the water: in proportion as the point of this shaft descends, the water boils; this boiling increases in proportion as the point approaches toward the surface, and the water of the sea rises in successive whirlings to a greater or smaller height, which, in the largest water-spouts, is about twenty-feet. The end of the shaft is always above this whirling, the size of which is proportioned to that of the water-spout which puts it in motion. The end of the shaft seems not to touch the surface of the sea, otherwise than by joining itself to the boiling or whirling which rises to meet it.

We sometimes see larger and smaller cones of water-spouts proceeding from the same cloud; some of them have the appearance of threads, and others are much larger. We often see ten or a dozen of small but complete water-spouts issuing from the same cloud, most of which are dissipated near their exit, and visibly ascend to the cloud. In this last case, the shaft suddenly swells as far as the inferior extremity, and appears like a cylinder suspended from the cloud, torn in pieces below, and of a small extent.

The water-spouts with broad bases gradually enlarge through their whole extent, and likewise in the under end, which seems to recede from the sea and to approach the cloud. The agitation and whirling they produce in the water gradually diminishes, and the under part of the shaft soon enlarges and assumes nearly a cylindrical form. It is in this state that the two sides of the canal widen; and we then see the water rushing with rapidity, and in a spiral form, into the cloud. Lastly, the appearance of the water-spout terminates by the successive shortening of this species of cylinder.

The largest water-spouts remain longest without dissipating; and some of them continue more than half an hour.

A torrent of rain generally rushes out of the same part of the cloud from which the water-spouts issue, and some of them not unfrequently still adhere to the cloud; these torrents of rain often conceal water-spouts before they are dissipated. I perceived distinctly, M. de la Nux remarks, on the 26th of October 1755, a water-spout in the middle of one of these torrents, which became so great that it was soon concealed from my view.

The wind, or the agitation of the air below the cloud, breaks neither the large nor the small water-spouts; for this impulsion only declines them from the perpendicular. The smallest kinds form very remarkable curves, and even sinuosities. The extremity which terminates in the sea is often far removed from the direction of the other which is attached to the cloud.

We never see new water-spouts formed after rain has fallen from the clouds which produced them.

'On the 14th day of June, 1756, about four o'clock in 'the afternoon, I was,' says M. de la Nux, 'on the margin 'of the sea, and above its level twenty or twenty-five 'feet. I saw twelve or fourteen water-spouts issue from 'the same cloud. Three of them only were considerable, and particularly the last. The canal in the mid'dle of the cylinder was so transparent, that, as the sun 'shone, I saw the clouds behind it. The cloud which 'produced so many water-spouts extended nearly from 'south-east to south-west; and the large water-spout 'under consideration appeared in the south-south-west 'from my station. The sun was very low; for the days 'were then about the shortest. I saw no rain proceed 'from the cloud: its height seemed to be from five to 'six hundred fathoms.'

The more the sky is obscured with clouds, water-spouts, and the phænomena which accompany them, are the more easily observed.

M. de la Nux thinks, and perhaps with reason, that water-spouts are nothing but viscous portions of a cloud driven off by different whirlwinds, *i. e.* by the whirlings of the superior air sinking into the mass of vapours of which the whole cloud is composed.

What seems to prove that these water-spouts are composed of viscous parts, is the tenaciousness of their cohesion; for they make inflexions and curvatures in every direction, without breaking: if the matter of water-spouts was not viscous, how can we conceive that they should, without breaking, bend and obey the motion of the winds? If all the parts did not firmly adhere, the wind would dissipate them, or, at least, make them change their form. But, as the form, both of the large and small water-spouts, is uniformly the same, this is almost a certain indication of the viscous tenacity of the matter of which they are composed.

Thus the basis of the matter of water-spouts is a viscous substance contained in the clouds, and every water-spout is formed by a whirlwind of air pressing through a mass of vapours, and, by blowing up the inferior part of the cloud, pierces it, and descends with its covering of viscous matter. And, as complete water-spouts descend from the cloud to the surface of the sea, the water must boil and whirl at the place to which the end of the water-spout is directed; because the air blows from the extremity of the water-spout like the tube of a pair of bellows. The effects of this blowing upon the sea will augment, in proportion as the cylinder approaches the surface of the water; and, when the orifice of the tube enlarges, a greater quantity of air is permitted to escape, and the agitation of the water is, of course, increased.

It has been imagined, that water-spouts carried off and contained great quantities of sea-water: the rains, or rather the spray, which often fall in the neighbourhood of water-spouts, have strengthened this prejudice. The canal in the middle of every species of water-spout is always transparent, on whatever side it is viewed. If the water of the sea seems to rise, it is not in this canal, but only on its sides. Almost every water-spout suffers inflections, and often in opposite directions, in the form of an *S*, the one end of which is in the cloud, and the other in the sea. Hence these water-spouts of which we have been treating, cannot contain water either to be poured into the sea, or raised to the cloud. Of course, they can be attended with no danger, except what proceeds from the impetuosity of the air which escapes from their inferior orifice; for we are assured by every person who has had an opportunity of observing these water-spouts, that they are solely composed of air confined in a viscous cloud, and determined by its whirling to the surface of the sea.

M. de la Nux has seen water-spouts around the isle of Bourbon in the months of January, May, June, and October, *i. e.* in all seasons of the year. He has seen them in calm weather, and during the highest winds. These phænomena, however, may be said to be rare, and seldom appear but upon the sea; because the viscosity of the clouds can only proceed from the bituminous and greasy particles raised, by the heat of the sun and the winds, from the waters of the sea, and collected in the clouds near its surface. It is for this reason that water-spouts seldom appear on land, where there is not, as on the surface of the sea, a sufficient quantity of bituminous and oily particles to be exhaled by the action of the sun. They are sometimes however observed on land, and even at great distances from the sea; this effect may be produced, when viscous clouds have been rapidly driven by a violent wind from the sea toward the land. M. Grignon, in the month of June 1768, saw a well formed water-spout in Lorrain near Vauvillier, among the hills which are a continuation of the Vosges. It was about fifty fathoms high. Its form was that of a column, and it communicated with a large thick cloud. It was impelled by one or several winds, which made the water-spout turn rapidly; and it produced lightning and thunder. This water-spout continued seven or eight minutes only, and broke upon the base of the hill, which is from five to six hundred feet high.

Water-spouts have been mentioned by several voyagers; but no man has examined them with such accuracy as M. de la Nux. For example, these voyagers tell us, that when water-spouts are forming a black smoke rises on the surface of the sea: this appearance, we are certain, is deceitful, and proceeds solely from the situation of the observer. If he is placed on a situation so elevated that the distance of the whirling excited in the water by the spout exceeds not his sensible horizon, he will see nothing but the water rising and falling back in rains without any mixture of smoke. This fact is apparent when the sun shines on the place where the phenomenon happens.

These water-spouts have nothing in common with those agitations and smoke sometimes produced by submarine fires, and of which we have formerly treated. Water-spouts neither contain nor excite any smoke. They are every where rare; they are most frequent in the seas of warm climates, and where, at the same time, calms are common, and the winds are most inconstant. They are likewise more frequent perhaps near islands and coasts than in the open sea.

ADDITIONS *to the Article, Of Earthquakes and Volcanoes,* Vol. I. p. 104.

I.

Of Earthquakes.

EARTHQUAKES are produced by two causes: the first is the sudden sinking of cavities in the bowels of the earth; and the second, which is still more frequent and more violent than the first, is the action of subterraneous fires.

When a cavern sinks in the middle of a continent, it produces a commotion which extends to a greater or smaller distance, in proportion to the quantity of motion excited by the fall of this mass of earth; and if this mass is inconsiderable, or falls from no great height, it will not produce a succussion so violent as to be perceived at a great distance; the effect is limited to the neighbourhood of the sunk cavern; and if the movement is propagated to greater distances, it is only by slight tremblings or vibrations.

As most of the primitive mountains rest upon caverns, because, at the moment of their consolidation, these eminences were blown up by the action of the internal fire, sinkings in the mountains have happened, and still happen, whenever the vaults of the caverns are undermined by water, or shaken by any convulsion. An entire portion of a mountain sometimes sinks perpendicularly, but oftener inclines, and not unfrequently reverses. Of this we have striking examples in several of the Pyrenees, where the strata, formerly horizontal, are often inclined more than forty-five degrees; which shows, that the entire mass of each portion of the mountain, whose strata were parallel to each other, has inclined by the lump, and in the moment of its sinking rested upon a base inclined to the horizon forty-five degrees. This is the most general cause of the inclination of strata in mountains. For the same reason we often find between the adjacent eminences strata which descend from the first and rise to the second, after having traversed the valley. These strata are horizontal, and are bedded at the same height in the two opposite hills, between which the cavern had fallen in. The earth sinks down, and the valley is formed, without producing any other derangement than a greater or smaller inclination of the strata, according to the depth of the valley, or the declivity of the two opposite hills.

This is the only sensible effect of the sinking of caverns in mountains and other parts of continents. But whenever this effect happens in the bottom of the sea, where sinkings must be more frequent than on the land, because the water perpetually undermines the vaults in every place where they support the bottom of the ocean, these sinkings not only derange and incline the strata, but sensibly lower the level of the sea. From the first occupation of the waters, their level has been depressed two thousand fathoms by these sinkings; and as all the submarine caverns have not yet fallen in, it is more than probable that the basin of the sea, by growing more and more deep, will lessen its surface, and of course that the extent of all the continents will always continue to augment by the retreat and sinking of the waters.

A second and more powerful cause than the first concurs in producing the same effect. This cause is the rupture and sinking of caverns by the action of submarine fires. It is certain, that no motion or sinking in the bottom of the sea can happen without diminishing its surface: and if we consider the general effects of subterraneous fires, we will perceive that as long as there is fire, the commotions of the earth will not be confined to simple tremblings; for the efforts of fire raise and open the sea and the land by violent and reïterated successions, which not only overturn and destroy the adjacent lands, but shake those that are distant, and ravage or derange every thing in the route of their direction.

The earthquakes occasioned by subterraneous fires generally precede eruptions of volcanoes, and sometimes cease the moment the fire opens a passage through the earth, and carries its flames into the air. These dreadful earthquakes sometimes continue during the whole time of eruptions. These two effects are intimately connected. There is never a great eruption of a volcano without being preceded, or at least accompanied, with an earthquake. But we often feel very violent succussions of the earth without any eruption of fire. Those movements, in which fire has no part, proceed not only from the first cause, the falling in of caverns, but likewise from the action of subterraneous winds and storms. There are many examples of lands raised or sunk by the force of these internal winds. Sir William Hamilton, a man as respectable for his private character, as admirable for the extent of his knowledge and researches on this subject, told me that he had seen between Trente and Verona, near the village of Roveredo, several little hills composed of large masses of calcareous stones, which had evidently been raised by different explosions of subterraneous winds. There is no indication of the action of fire upon any of these rocks or their fragments. The whole country, on both sides of the highway, for an extent of near a league, has from place to place been overturned by the prodigious efforts of subterraneous winds: the inhabitants say that it happened suddenly, and was the effect of an earthquake.

But the force of the wind, however violent, appears not to be a cause sufficient to produce such great effects; and though there be no marks of fire in these little hills raised by the commotion of the earth, I am persuaded that they have been elevated by electrical explosions of subterraneous thunder; and that the internal winds have contributed to this effect solely by producing electrical storms in the cavities of the earth. Hence all convulsive movements of the earth may be referred to three causes: the first and most simple is, the sinking of caverns; the second, storms and subterraneous thunder; and the third, the action of fire kindled in the interior parts of the globe. It is easy to ascribe to one or other of these three causes all the phenomena which accompany or succeed earthquakes.

Commotions of the earth sometimes give rise to eminences; but they more frequently produce gulfs. On the 15th day of October 1773, a gulf opened in the territory of Induno, in the state of Modena, the cavity of which was more than four hundred fathoms wide by two hundred fathoms deep. In 1726 a mountain of a considerable height, situated in the northern part of Iceland, was sunk in one night by an earthquake, and a very deep lake assumed its place. The same night, about a league and a half distant, an ancient lake, the depth of which was unknown, was entirely dried up, and its bottom raised in such a manner as to form a pretty high hill, which still exists. In the seas in the neighbourhood of New Britain M. Bougainville remarks, earthquakes have terrible effects on navigation. On the 17th of June, the 12th and 27th of July 1768, there were three earthquakes at Boero, and on the 22d of the same month one at New Brittany. These earthquakes sometimes annihilate islands and known sand-banks, and sometimes create them.

There are earthquakes which extend to great distances; but they are always longer than broad. One of the most considerable was that felt in Canada in the year 1663. It extended more than two hundred leagues in length and one hundred in breadth, *i. e.* more than twenty thousand superficial leagues. The effects of the last earthquake in Portugal, which happened in our own time, were felt still farther. M. le Chevalier de Saint-Sauveur, King's commandant at Merucis, informed M. de Gensanne, that when walking on the left margin of Jouante in Languedoc, the sky suddenly became very dark, and that in a moment after he perceived at the foot of the hill which is situated to the right of that river, a terrible bright globe of fire: immediately there arose from the bowels of the earth a considerable mass of rocks, and the whole chain of mountains split from Merucis to Florac, an extent of near six leagues. This rent in some places is more than two feet wide, and has partly fallen in. There are other earthquakes which produce little or no commotion. Kolbe relates, that on the 24th of September 1707, from eight to ten o'clock before noon, the sea rose upon the land at the Cape of Good Hope and descended seven times successively, and with such rapidity, that from one moment to another the place was alternately covered and left by the waters.

With regard to the effects of earthquakes, the falling of mountains, and the sinking of caverns, I shall subjoin a few facts, which are both recent and well attested. In Norway a whole promontory, called Hammersfields, suddenly fell. A very high mountain, near that of

Chimboraco, one of the highest of the Cordeliers in the province of Quito, tumbled down in a moment. This fact, with all its circumstances, is related in the memoirs of M. de la Condamine and Bouguer. Similar fallings and sinkings often happen in the southern islands of India. At Gamma-canore, where the Dutch have a settlement, a high mountain fell suddenly in the year 1673, when the weather was fine: it was followed by an earthquake, which overturned the neighbouring villages, and destroyed several thousands of persons. On the 11th of August, 1772, in the island of Java and province of Cheribou, one of the richest settlements of the Dutch, a mountain, of about three leagues in circumference, suddenly sunk, and rose and sunk alternately like waves in a stormy ocean: it at the same time threw out many globes of fire, which were seen at a great distance, and gave a light as brilliant as that of day: all the plantations, together with about two thousand one hundred and forty inhabitants, without reckoning strangers, were entirely swallowed up. We might recite many other examples of the sinking of lands and swallowing of mountains by the rupture of caverns, and the succussions occasioned by earthquakes and the action of volcanoes: but we have said enough to establish the general conclusions we have drawn from the facts already related.

II.

Of Volcanoes.

The ancients have left us some notices concerning the volcanoes which were known to them, and particularly those of Ætna and Vesuvius. Several learned and curious observers have in our days examined more minutely the form and effects of these volcanoes. On comparing their descriptions, the first observation that presents itself, is the folly of transmitting to posterity the exact topography of these burning mountains. Their form may be said to change daily; their surface rises or sinks in various places; every eruption produces new gulfs or new eminences: to attempt to describe all these changes, is to follow and paint the successive ruins of a burning edifice. The Vesuvius of Pliny, and the Ætna of Empedocles, present very different aspects from those which have been so ably delineated by Sir William Hamilton and Mr. Brydone; and, in a few ages, these recent descriptions will no longer resemble their objects. Next to the surface of the ocean, nothing on this globe is so fluctuating and inconstant as the surface of volcanic mountains: but even from this inconstancy, and from the variation of form and movements, some general conclusions may be drawn, by bringing particular observations under one point of view.

III.

Of the Changes which have happened in Volcanoes.

The base of Ætna is about sixty leagues in circumference, and its perpendicular height about two thousand fathoms above the level of the Mediterranean sea. We may, therefore, regard this enormous mountain as an obtuse cone, the superfices of which is not less than three hundred square leagues. This conical surface is divided into four zones, situated concentrically above each other. The first is the largest, and, by a gradual ascent, extends above six leagues from the most distant point at the foot of the mountain. This zone of six leagues broad is almost totally peopled and cultivated. The city of Catania, and several villages are situated in this first zone, the surface of which exceeds two hundred and twenty square leagues. The basis of this vast territory consists of various strata of ancient and modern lavas, that have run from different parts of the mountain, from which explosions of subterraneous fires have issued. The surface of this lava, mixed with ashes thrown out from different craters, is converted into a fine soil, which is now sown with grain and planted with vines, except in a few places where the lava is too recent, and still remains uncovered with earth. About the top of the zone, we still see several craters, more or less large and deep, from which the materials issued that have formed the upper stratum or soil.

The second zone commences at the termination of these six leagues. This second zone is an ascent of about two leagues broad. Its declivity is every where more rapid than that of the first zone; and this rapidity augments in proportion as you approach toward the sumit. The surface of this second zone is about forty or forty-five square leagues: its whole extent is covered with magnificent forests, and form a fine belt of verdure to the white and hoary head of this venerable mountain. The soil of these fine forests is nothing but lava and ashes converted by the operation of time into excellent earth. What is still more remarkable, the surface of this zone is so unequal, that it every where presents hills, or rather mountains, all of which have been produced by different eruptions from the summit of Ætna, and other craters below the summit, several of which have formerly acted in this very zone, now converted into forests.

Before arriving at the summit, and after having passed these fine forests, we traverse a third zone, which gives birth to small vegetables only. In winter, this region is covered with snow, which melts in summer. We afterwards meet with a line of permanent snow, which marks the commencement of the fourth zone, and extends to the top of the mountain. These snows and ice occupy about two leagues from the region of small vegetables to the summit, which is likewise covered with snow and ice. Its figure is an exact cone; and it contains the greater crater of the volcano, from which are continually discharged immense volumes of smoke. The internal figure of the crater is that of an inverted cone. It is composed of nothing but ashes and other burnt matters thrown out by the mouth of the crater, which is in the centre of the volcano. The external surface of the summit is very rough. The snow is covered with ashes, and the cold is very piercing. On the north side of this region of snow, there are several small lakes which never freeze. In general, the surface of this last zone is pretty equal, and observes the same declivity, except in a few places; and it is below this region only where we meet with a great number of inequalities, eminences, and hollows produced by eruptions, and where we see hills and mountains more or less recently formed, and composed of burnt matters rejected by these different mouths or craters.

In 1770, according to Mr. Brydone, the crater on the top of Ætna was more than a league in circumference; and very different dimensions have been ascribed to it both by ancient and modern authors. All these authors, however, were right; for the dimensions of this mouth of fire have undergone many alterations. All we can infer from the various descriptions that have been given of it, is, that the crater with its margins have been four times overturned within these six or seven hundred years. The materials of which it is composed fall back into the bowels of the mountain, are again rejected by fresh eruptions, and form a new crater, which augments and rises by degrees, till it again falls back into the great gulf of the volcano.

The top of the mountain is not the only place from which the subterraneous fire has been discharged. Through the whole territory which forms the sides and ridge of Ætna, and at great distances from the summit, there are many craters which give passage to the fire, and which are surrounded with broken rocks that had been discharged by different eruptions. We may even reckon several hills formed by the eruptions of these small volcanoes which surround the great one. Each of these hills has a crater at its top, in the centre of which is a deep mouth or gulf. Every eruption of Ætna has produced a new mountain; and, perhaps, Mr. Brydone remarks, their number would determine, better than any other method, that of the eruptions of this famous volcano.

The city of Catania, which is situated at the foot of Mount Ætna, has often been laid in ruins by the lavas which issued from these new mountains during the time of their formation. In ascending from Catania to Nicolosi, we traverse twelve miles through a country formed by ancient lavas, where we see the mouths of extinguished volcanoes, which at present are fertile lands, covered with grass, corn, and vineyards. The lavas which form this region proceeded from the eruptions of the small mountains, which are every where dispersed over the sides of Ætna: they are all, without exception, either regular hemispheres or cones. In general every eruption raised one of these mountains. Hence the action of the subterraneous fires does not always reach the summit of Ætna. They often issue from the sides, and even from the foot of this burning mountain. Each eruption from the sides of Ætna commonly produces a new mountain composed of rocks, stones, and ashes projected to a great distance by the force of the fire; and the magnitude of these new mountains is proportioned to the duration of the eruption. If it continues but a few days, it produces only a little hill, about a league in circumference at the base, and three or four hundred feet in perpendicular height. But if the eruption continues some months, like that of 1669, it then gives rise to a considerable mountain of two or three leagues in circumference, and nine hundred or a thousand feet high; and all these hills produced by Ætna, some of which are twelve thousand feet high, appear only as small elevations intended to accompany the majesty of the parent mountain.

In Vesuvius, which is a very small volcano when compared with Ætna, eruptions from the sides of the mountain are rare, and the lava generally issues from the crater at the summit. But in Ætna eruptions more frequently proceed from the sides than the top, and lava issues abundantly from every new mountain formed by these eruptions. Mr. Brydone, according to the information he received from M. Recupero, says, that the masses of stones projected from Ætna rise to such a height, that they take twenty-one seconds of time in descending to the earth; while those of Vesuvius fall in nine seconds; hence the stones projected by Vesuvius rise to the height of 1215 feet, and those projected by Ætna rise 6615; from which we may conclude, if the observations be accurate, that the force of Ætna is to that of Vesuvius as 441 to 81, *i. e.* five or six times greater. That Vesuvius is a very feeble volcano, when compared to Ætna, is proved in a more forcible manner by this circumstance, that Ætna has actually produced other volcanoes which are larger than that of Vesuvius.

‘Not a great way from this cavern are two of the most beautiful mountains of all that number that spring from Ætna. I mounted one of our best mules, and with a good deal of difficulty arrived at the summit of the highest of them, just a little before sunset. The prospect of Sicily, with the surrounding sea and all its islands, was wonderfully noble. The whole course of the river Semetus, the ruins of Hybla, and several other ancient towns; the rich corn fields and vineyards on the lower region of the mountain, and the amazing 'number of beautiful mountains below, made a delightful scene. The hollow craters of these two mountains are each of them considerably larger than that of Vesuvius. They are now filled with stately oaks, and covered to a great depth with the richest soil. I observed that this region of Ætna, like the former, is composed of lava; but this is now covered so deep with earth, that it is no where to be seen but in the beds of the torrents. In many of these it is worn down by the water to the depth of fifty or sixty feet, and in one of them still considerably more. This conical mountain is of a very great size; its circumference cannot be less than ten miles. Here we took a second rest, as the greatest part of our fatigue still remained. The mercury had fallen to 20 : 4½.—We found this mountain excessively steep; and although it had appeared black, yet it was likewise covered with snow.—The present crater of this immense volcano is a circle of about three miles and a half in circumference. It goes shelving down on each side, and forms a regular hollow like a vast amphitheatre. From many places of this space issue volumes of sulphureous smoke, which being much heavier than the circumambient air, instead of rising in it, as smoke generally does, immediately on its getting out of the crater, rolls down the side of the mountain like a torrent, till coming to that part of the atmosphere of the same specific gravity with itself, it shoots off horizontally, and forms a large track in the air, according to the direction of the wind; which, happily for us, carried it exactly to the side opposite to that where we were placed. The crater is so hot, that it is very dangerous, if not impossible, to go down into it; besides, the smoke is very incommodious, and in many places the surface is so soft there have been instances of people sinking down in it, and paying for their temerity with their lives. Near the centre of the crater is the great mouth of the volcano.—When we arrived at the foot of the cone, we observed some rocks of an incredible size, that have been discharged from the crater. The largest that has been observed from Vesuvius is a round one, of about twelve feet in diameter. These are much greater; indeed almost in proportion of the mountains to each other.'

As all that region from the top of Ætna to the distance of two leagues below presents an equal surface, without hills or valleys, and as the ruins of Empedocles the philosopher's tower, who lived four hundred years before the Christian æra, are still to be seen, it is probable that during all this period the great crater has made few or no eruptions. Hence the force of the fire has diminished, as it no longer acts with violence at the summit, and as all the modern eruptions have happened in the lower regions of the mountain. However, within these few centuries the dimensions of the great crater have been often changed, as appears from the measurement of Sicilian authors at different periods. Sometimes it falls down, and is again gradually elevated till it falls afresh. The first of these fallings, which are well attested, happened in the year 1157, a second in 1329, a fourth in 1444, and the last in 1669. But from these facts we should not conclude, as Mr. Brydone has done, that the crater will soon suffer another overthrow. The notion, that this effect should be produced every hundred years, seems to have no foundation. I should rather imagine, that as the fire no longer acts with violence at the summit, its force has diminished, and will continue to diminish, in proportion as the sea retires; it has already retired several miles by the action of the volcano, which has formed large banks and bulwarks by vast torrents of lava. Besides, we know from the diminished rapidity of Scylla and Charybdis, and several other indications, that the Sicilian sea has sunk considerably within these two thousand five hundred years. We may therefore conclude, that this sea will continue to sink, and of course that the action of the neighbouring volcanoes will not relax; so that the crater of Ætna may remain during a long time in its present state; and if ever it falls back into the gulf, it will probably be for the last time. I farther presume, that Ætna ought to be regarded as one of the primitive mountains, on account of its height and the immensity of its size, and that it began to act at the remote period when the waters first retreated. Its action, however, ceased after this retreat, and was not renewed till that modern period when the Mediterranean sea, being elevated by the rupture of the Bosphorus and the Straits of Gibraltar, deluged the land between Sicily and Italy, and approached to the basis of Ætna. Perhaps the first of these eruptions is still posterior to this epoch of nature. 'It is evident,' Mr. Brydone remarks, 'that Ætna did not burn in the days of Homer, nor for a long time before, otherwise it would have been impossible that this poet should have talked so much of Sicily, without mentioning an object so astonishing.' This remark of Mr. Brydone is extremely just; and of course the first known eruptions of Ætna should be dated after the age of Homer. But we perceive, from the poetical allusions of Pindar and Virgil, and from the descriptions of ancient and modern authors, that in the space of eighteen or nineteen centuries the whole face of this mountain and of the adjacent country has been changed by earthquakes, eruptions, torrents of lava, and the formation of hills and gulfs by these commotions. For the facts above related I am indebted to Mr. Brydone's excellent performance; and I have too high an esteem for Mr. Brydone to believe that he can be offended because I do not agree with him as to the force of volcanoes, and some other conclusions he has drawn from these facts. No preceding author has observed with equal acuteness, or presented such lively pictures of the objects he surveyed; the whole republic of letters therefore ought to unite in celebrating a work so deserving of approbation.

Torrents of glass in fusion, which have received the denomination of lavas, are not the first effects of eruptions. These eruptions are commonly announced by an earthquake more or less violent, which is the first effort of the subterraneous fire to escape from the bowels of the earth; it soon, however, opens a passage, which it enlarges by projecting rocks and every obstruction to its motion. These materials, which are exploded to a great height, fall back upon each other, and form an eminence more or less considerable in proportion to the duration and violence of the eruption. As all the rejected matters are penetrated by fire, and most of them converted into burning ashes, the eminence to which they give rise is a mountain of solid fire, in which a great part of the matter is melted by the fervency of the heat. This melted matter soon begins to run, and generally flows to the foot of the new mountain by which it was produced. But in small volcanoes, which have not force sufficient to throw the ejected matters to a great distance, the lava issues from the top of the mountain. This effect is conspicuous in the eruptions of Vesuvius. The lava rises in the centre of the crater. The volcano first throws out stones and ashes, which fall perpendicularly back into the old crater and augment its size. It is through this additional matter, which has fallen back, that the lava opens a passage. These two effects, though different in appearance, are nevertheless the same; for in a small volcano, which like Vesuvius has not force enough to give birth to new mountains by projecting its materials to a distance, the whole fall back upon the summit and increase its height; and it is at the foot of this new crown of matter that the lava forces its way and flows down the mountain. This last effort is generally succeeded by a repose of the volcano. The succussions of the earth within, and the projections without, cease as soon as the lava flows. But the torrents of this glass in fusion produce effects still more extensive and disastrous than the convulsions of the mountain during an eruption. These rivers of fire ravage, destroy, and disfigure the surface of the earth. Nothing can oppose their dreadful progress. Of this the unfortunate inhabitants of Catania have had fatal experience. As their city had often been destroyed, either wholly or in part, by these torrents of lava, they built very strong walls of fifty-five feet in height. Surrounded by these ramparts they believe themselves to be safe. The walls, it is true, resisted the heat and the weight of the torrent. But this resistance served only to dam up the lava, which rose above the ramparts, fell back upon the city, and ravaged every thing in its progress.

These torrents of lava are often half a league, and sometimes even two leagues broad.

'The last lava we crossed before our arrival at Catania is of a vast extent. I thought we never should 'have done with it; it certainly is not less than six or 'seven miles broad, and appears in many places to be of 'an enormous depth.

'When we came near the sea I was desirous to see 'what form it had assumed in meeting with the water. 'I went to examine it, and found it had driven back the 'waves for upwards of a mile, and had formed a large 'black high promontory, where before it was deep 'water. This lava, I imagined, from its barrenness, for 'it is as yet covered with a very scanty soil, had run 'from the mountain only a few ages ago; but was surprised to be informed by Signior Recupero, the historiographer of Ætna, that this very lava is mentioned 'by Diodorus Siculus to have burst from Ætna in the 'time of the second Punic war, when Syracuse was besieged by the Romans. A detachment was sent from 'Tauromiuum to the relief of the besieged. They were 'stopped on their march by this stream of lava, which 'having reached the sea before their arrival at the foot 'of the mountain, had cut off their passage; and obliged 'them to return by the back of Ætna, upwards of 100 'miles about. His authority for this, he tells me, was 'taken from inscriptions on Roman monuments found 'on this lava, and that it was likewise well ascertained 'by many of the old Sicilian authors. Now as this is 'about 2000 years ago one would have imagined, if 'lavas have a regular progress in becoming fertile fields, 'that this must long ago have become at least arable; 'this however is not the case, and it is as yet only covered with a very scanty vegetation, and incapable of 'producing either corn or vines. There are indeed 'pretty large trees growing in the crevices, which are 'full of a rich earth; but in all probability it will 'be some hundred years yet before there is enough 'of it to render this land of any service to the proprietors.

'We passed the river Alcantara on our way to Piedmonte, over a large bridge built entirely of lava: and 'near to this the bed of the river is continued for a 'great way, through one of the most remarkable, and 'probably one of the most ancient lavas that ever run 'from Ætna. In many places the current of the river, 'which is extremely rapid, has worn down the solid 'lava to the depth of 50 or 60 feet. Recupero, the 'gentleman I have mentioned, who is engaged in writing 'the natural history of Ætna, tells me, he had examined 'this lava with great attention, and he thinks that its 'course, including all its windings, is not less than 40 'miles. It issued from a mountain on the north side of 'Ætna, and finding some valleys that lay to the east, 'it took its course that way, interrupting the Alcantara in many places, and at last arrived at the sea not far from the mouth of that river.

‘The city of Jaci or Aci, and indeed all the towns on this coast, are founded on immense rocks of lava, heaped one above another, in some places to an amazing height; for it appears that these flaming torrents, as soon as they arrived at the sea, were hardened into rock, which not yielding any longer to the pressure of the liquid fire behind, the melted matter continuing to accumulate, formed a dam of fire, which in a short time run over the solid front, pouring a second torrent into the ocean: this was immediately consolidated, and succeeded by a third, and so on. The road from Jaci to this city is entirely over lava, and consequently very fatiguing and troublesome. Within a few miles of that place we counted eight mountains formed by eruptions, with every one its crater, from whence the burnt matter was discharged. Some of these are very high, and of a great compass. It appears evidently, that the eruptions of Mount Ætna have formed the whole of this coast, and in many places have driven back the sea for several miles from its ancient boundary. At Catania, near to a vault, which is now thirty feet below ground, and has probably been a burial place, there is a draw-well, where there are several strata of lavas, with earth to a considerable thickness over the surface of each stratum. Recupero has made use of this as an argument to prove the great antiquity of the eruptions of his mountain. For if it requires two thousand years or upwards to form but a scanty soil on the surface of a lava, there must have been more than that space of time betwixt each of the eruptions which have formed these strata. But what shall we say of a pit they sunk near to Jaci, of a great depth? They pierced through seven distinct lavas one under the other, the surfaces of which were parallel, and most of them covered with a thick bed of rich earth. Now, says he, the eruption which formed the lowest of these lavas, if we may be allowed to reason from analogy, must have flowed from the mountain at least 14,000 years ago.

‘The great eruption of 1669, after shaking the whole country around for four months, and forming a very large mountain of stones and ashes, burst out about a mile above Monpelieri, and descending like a torrent, bore directly against the middle of that mountain, and (they pretend) perforated it from side to side: this however I doubt, as it must have broken the regular form of the mountain, which is not the case. But certain it is that it pierced it to a great depth. The lava then divided into two branches; and surrounding this mountain, joined again on its south side; and laying waste the whole country betwixt that and Catania, scaled the walls of that city, and poured its flaming torrent into the ocean. In its way it is said to have destroyed the possessions of near 30,000 people, and reduced them to beggary. It formed several hills where there were formerly valleys, and filled up a large lake, of which there is not now the least vestige to be seen. There is no part of the coast from Catania to Syracuse nearer than thirty miles to its summit; and yet there has hardly been any great eruption where the lava has not reached the sea, and driven back its waters to a great distance, leaving high rocks and promontories that for ever set its waves at defiance, and prescribe their utmost limits. What a tremendous scene must the meeting betwixt these adverse elements have formed!

‘We may easily conceive the variety of changes this coast has undergone in the space of some thousands of years, as every great eruption must have made a considerable difference. Virgil is wonderfully minute and exact in his geography of Sicily; and this is the only part of the island that seems to be materially altered since his time. He says there was a very large port at the foot of Ætna, where ships were secure from every wind; of which at present there are not the least remains. It is probably the same that was called by the Sicilians the port of Ulysses; which is often mentioned by their writers. The place of its existence is still shown betwixt three or four miles up the country, amongst the lavas of Ætna.

‘The circumference of the great base of Ætna, Recupero told me, he had been at a good deal of pains to ascertain; as it had generally been computed only at a hundred miles, or a little more, although the radii of that circle had ever been esteemed at thirty of those miles; an absurdity in computation that had put him upon making this enquiry. The result was, that taking the supposed distances of one place from another, all the way round, the sum of the whole amounted to one hundred and eighty-three miles: an immense circle surely, and which is still enlarged by every considerable eruption.’

Here we have a territory of about 300 superficial leagues, all covered or formed by the projections of volcanoes. In this territory, independent of the peak of Ætna, there are many other mountains, all of which are furnished with craters, and exhibit an equal number of particular volcanoes. Ætna therefore must not be regarded as a single volcano, but as an assemblage of volcanoes, the greater part of which are extinguished, or burn with a gentle fire, and a few of them still act with violence. At present the summit of Ætna throws out nothing but smoke; and there seems to have been no eruption from it for a very long period of time; because it is surrounded, to the distance of two leagues, with an equal surface, and below this high region covered with snow we find a large zone of vast forests, the soil of which is a fertile earth of several feet in thickness. This inferior zone is interspersed with inequalities, and presents heigths, valleys, hills, and even pretty large mountains. But as almost the whole of these inequalities are covered with a great thickness of earth, and as a long succession of time was necessary to convert volcanic matters into vegetable soil, we should regard the summit of Ætna, and the other mouths which surround it to the distance of four or five leagues, as volcanoes almost extinct, or at least stifled for a number of ages; for all the eruptions, the dates of which can be ascertained for two thousand five hundred years, have happened in the lower region, *i. e.* five, six, or seven leagues distant from the summit. The volcanoes of Sicily seem to have had two different ages: the first very ancient, when the summit of Ætna began to act, and when the universal ocean left this summit dry and sunk some hundreds of fathoms below: it was at this period that the first eruptions happened, which produced lava at the summit, and gave rise to those hills found below in the region of forests; but afterwards, the waters continuing to sink, they totally abandoned this mountain, as well as the territories of Sicily and the adjacent continents. After this total retreat of the waters, the Mediterranean was only a lake of a moderate extent, and its waters were very distant from Sicily and all the countries whose coasts it now washes. During all this time, which lasted several thousand years, Sicily was perfectly tranquil: Ætna, and the other ancient volcanoes which surround its summit, had ceased to act; and it was not till after the augmentation of the Mediterranean by the waters of the ocean and of the Black Sea, *i. e.* after the rupture of the straits of Gibraltar and of the Bosphorus, that the waters attacked the bases of the new mountains of Ætna, and produced those modern eruptions which have happened since the age of Pindar to the present time; for this poet is the first author who has taken notice of eruptions of volcanoes in Sicily. Vesuvius was precisely in the same situation. It was long one of the extinguished volcanoes of Italy, which are very numerous; and their eruptions were not renewed till after the waters of the Mediterranean were increased and reached the bases of these inflammable mountains. The memory of the first eruptions, and even of all those which preceded the age of Pliny, was entirely obliterated. Neither should this circumstance excite surprise; for ten thousand years have perhaps elapsed since the general retreat of the waters to the augmentation of the Mediterranean, and an equal portion of time from the first eruption of Vesuvius to their removal. All these considerations seem to prove that subterraneous fires cannot act with violence, unless when they are so near the sea as to receive a shock from a great body of water. This reasoning is confirmed by other phenomena: volcanoes sometimes throw out great quantities of water, and likewise torrents of bitumen. P. de la Torré, an able philosopher, relates, that on the 10th of March 1755, an immense torrent of water issued from the foot of the mountain which deluged the neighbouring country. This torrent brought down such a quantity of sand that it covered an extensive plain. These waters were very hot. The stones and sand left on the plain differed not from those found in the sea. The torrent of water was immediately followed by another of inflamed matter, which proceeded from the same opening.

The same eruption, 1755, was preceded, says M. D'Arthenay, by an inflammation so great, that it illuminated more than twenty-four miles of country along the coasts of Catania. The explosions were soon so frequent that on the 3d of March we perceived a new mountain in the top of the old summit, in the same manner as lately happened to Vesuvius. Lastly, the magistrates of Mascali informed us, that on the 9th of the same month the explosions were terrible; that the whole sky was darkened with smoke; that on the approach of night it began to rain a deluge of small stones, some of which weighed three ounces, and covered all the adjacent cantons; that this tremendous rain continued an hour and a quarter, and was succeeded by another of black ashes, which lasted the whole night; that the next day, about eight o'clock in the morning, the summit of Ætna threw out a river of water, which for magnitude might be compared to the Nile; that the most ancient and rugged mountains of lava were in an instant converted by this torrent into a vast plain of sand; that the water, which fortunately ran not above half a quarter of an hour, was very hot; that the stones and sand carried along with it differed not from those of the sea; that after this inundation there issued from the same mouth a small rivulet of fire, which flowed during twenty-four hours; that on the 11th, about a mile below this mouth, a rent happened through which issued a stream of lava of about a hundred fathoms broad by two miles in length, and that it continued its course through the country the same day in which M. D'Arthenay wrote this relation.

Let us attend to what Mr. Brydone has remarked concerning this eruption. 'Part of the fine forests which 'compose the second region of Ætna was destroyed by 'a very singular event, not later than 1755. During an 'eruption of the volcano, an immense torrent of boiling 'water issued, as is imagined, from the great crater of 'the mountain, and in an instant poured down to its 'base; overwhelming and ruining every thing it met 'with in its course. Our conductors shewed us the 'traces of this torrent, which are still very visible; but 'are now beginning to recover verdure and vegetation, 'which for some time appeared to have been lost. The 'track it has left seems to be about a mile and a half 'broad; and in some places still more.

'The common opinion, I find, is, that this water was 'raised by the power of suction, through some commu-

'nication betwixt the volcano and the sea; the absurdity 'of which is too glaring to need a refutation. The 'power of suction alone, even supposing a perfect 'vacuum, could never raise water to more than thirty-'three or thirty-four feet, which is equal to the weight of 'a column of air the whole height of the atmosphere.'

I must here observe, that Mr. Brydone seems to have deceived himself; for he confounds the force arising from the weight of the atmosphere with the force of suction produced by the action of fire. The force of the air, when a vacuum is made, is indeed limited to thirty-four feet. But the force of suction by fire has no limits: it is always proportioned to the quantity and intensity of the heat by which it is produced, as is evident from the common effects of blast furnaces. Hence the opinion of the *enlightened people of the country*, instead of being absurd, seems to be well founded. It is necessary that the cavities of volcanoes should communicate with the sea: without this communication such immense torrents of water could not be thrown out, nor indeed could any eruption ever happen; for no power, except the shock produced by the mingling of fire and water, could give rise to such violent effects.

The volcano of Pacayita, called the *water volcano* by the Spaniards, in all its eruptions throws out torrents of water. The last eruption, in the year 1773, destroyed the city of Guatimala, and the torrents of water and lava descended to the South Sea.

With regard to Vesuvius it has been remarked, that a wind which blows from the sea penetrates into the mountain. The noise it makes in certain cavities is heard as if some torrent passed below: this noise ceases whenever the land winds blow, and at the same time the exhalations from the mouth of Vesuvius become less considerable. But when the wind blows from the sea, this noise, which resembles that of a torrent, recommences, and the exhalations of flame and smoke increase. The water of the sea, by thus insinuating itself into the mountain, sometimes in greater, and sometimes in smaller quantities, is the reason why this volcano has often thrown out both ashes and water.

The learned M. D'Arthenay, who has compared the modern with the ancient state of Vesuvius, relates, that during the interval which preceded the eruption of 1631, the funnel of the crater of the mountain was covered with trees and verdure; that the small plain which bounds it produced excellent pasture; that in departing from the superior margin of the crater we have a mile to descend before we arrive at this plain, in the middle of which was another gulf. We descended this gulf about a mile, by narrow and winding roads of an equal declivity, which led into a vast space surrounded with caverns, from whence there issued *winds so impetuous and so cold that it was impossible to endure them.* According to the same observer the summit of Vesuvius was then five miles in circumference. We should not therefore be surprised, that some philosophers have maintained that what seems now to be two mountains was formerly one; that the volcano was in the centre, but that the south side having fallen by the force of some eruption produced the valley which separates Vesuvius from Mount *Somma.*

M. Steller remarks, that the volcanoes in the north of Asia are almost always *isolated;* that they have nearly the same surface; and that there are always lakes on the summits, and hot waters at the foot of those mountains whose volcanoes are extinct. This, he adds, is a farther proof of the correspondence established by nature between the sea, mountains, volcanoes, and hot waters. We find many springs of hot water in different parts of Kamtschatka. In the island of Sjnaw, forty leagues distant from Ternate, there is a volcano which often throws out water, ashes, &c. But it is unnecessary to accumulate more facts to prove the communication of volcanoes with the sea. The violence of their eruptions would be sufficient to justify the presumption; and the general fact, that all acting volcanoes are situated near the sea, completes the demonstration. However, as some philosophers have denied the reality and even the possibility of this communication of volcanoes with the sea, I shall mention another fact related by M. de la Condamine, a man equally enlightened as worthy of credit. 'On the 14th of June, 1755,' he remarks, 'I 'mounted to the summit of Vesuvius, and even to the 'brink of the funnel formed round the mouth of the 'volcano by its last explosion; and I perceived in the 'gulf about forty fathoms deep, a great cavity resembling 'a vault, toward the north of the mountain. I threw 'down large stones into this cavity, and counted twelve 'seconds before the noise of their rolling ceased. At the 'end of their fall I heard a noise similar to that of a 'stone falling into a mire; and when nothing was 'thrown in I heard a noise like that of agitated waves.' If the fall of the stones had been perpendicular, and met with no obstacle, twelve seconds would have given a depth of 2160 feet, and the bottom of the gulf would, on this supposition, be deeper than the level of the sea; for according to le P. de la Torré, in 1753 this mountain was only 1677 feet above the surface of the sea, and this elevation has been diminished since that period. Hence we may conclude, that the caverns of this volcano descend below the level of the sea, and of course they may have subterraneous communications.

On the 15th of July 1753 I received from an eye-witness, and an accurate observer, a distinct detail of the then condition of Vesuvius. I shall subjoin it in the words of the author, because it will tend to fix our ideas concerning what is to be farther apprehended from the effects of this volcano, the force of which seems to be greatly diminished.

'Having arrived at the foot of the mountain, which 'is about two leagues distant from Naples, we mounted 'during an hour and a half upon asses, and an equal 'portion of time was employed in completing the jour'ney on foot. This is the steepest and most fatiguing 'part of the way. We held by the belts of two men 'who went before, and we climbed among ashes and 'stones formerly exploded.

'In our ascent, we saw the lavas of different erup'tions. The most ancient, whose age is uncertain, but 'tradition assigns it two hundred years, is of an iron'gray colour, and has all the appearance of a stone: it 'is used for paving the streets of Naples, and in other 'works of masonry. We found others which were said 'to be sixty, forty, and twenty years old. The last was 'thrown out in the year 1752. These different lavas, 'except the most ancient, when viewed at a distance, 'have the appearance of a blackish brown rugged earth, 'more or less recently laboured. When viewed nearer, 'it is a matter perfectly similar to the refuse of iron 'foundries. It is more or less composed of earth and 'ferruginous matter, and approaches more or less to the 'nature of stone.

'When arrived at the top, which before the eruption 'was solid, we find the first basin, whose circumference 'is said to be two Italian miles, and its depth appears 'to be about forty feet. It is surrounded with a crust 'of earth, which gradually thickens toward the base, 'and its upper margin is two feet broad. The bottom 'of this basin is covered with a greenish yellow sulphu'reous matter, which is hard and warm, but does not 'burn; and smoke issues through different fissures.

'In the centre of this basin we see a second, which 'is about half the circumference and half the depth of 'the former. Its bottom is covered with a blackish 'brown matter, similar to the freshest lavas we find on 'the road.

'In the second basin there is a small mount, which 'is hollow internally, open at the top, and likewise open 'from the top to the base toward that side of the moun'tain where we ascended. This lateral opening is about 'twenty feet broad at the top, and four feet at the base. 'The height of this small mount is about forty feet; 'the diameter of the base is about as much, and that of 'the opening at the top about twenty feet.

'This base rises about twenty feet above the second 'basin, and forms a third basin, which is filled with a 'liquid and burning matter, and has a perfect resem'blance to the melted metal in an iron furnace. This 'matter perpetually boils with great violence. Its 'movements have the appearance of a lake moderately 'agitated, and the noise it produces is similar to that of 'waves.

'Every minute, quantities of this matter are projected 'into the air, like water thrown up by many jets-d'eaux. 'These projections produce the appearance of burning 'sheafs of wheat, which rise to the height of thirty or 'forty feet, and fall back in various curves, partly into 'their own basin, and partly the second, which is co'vered with a black matter. It is the reflected light of 'these burning jets which is seen from Naples during 'the night. The noise they make in their elevation and 'fall seems to be composed of that of fire-works, and 'the noise produced by the waves of the sea, when vio'lently dashed against a rock.

'The boilings and jets produce a perpetual evacuation 'of this matter. Through the aperture of four feet, at 'the base of the small mount, a burning rivulet of the 'same dimensions with the aperture continually flows, 'and descends in an inclined canal, and with a mean 'movement, into the second basin, where, after dividing 'into several rills, it stops and is extinguished.

'This burning rivulet consists of fresh lava, which 'runs only eight days. But if it continues to augment, 'it will in time produce a new overflowing into the plain, 'similar to that which happened two years ago. The 'whole is accompanied with a thick smoke, which has 'not the odour of sulphur, but precisely that which pro'ceeds from a furnace where tiles are roasted.

'We may, without danger, go round the margin of 'the crater; because the little hollow mount, from 'which the burning projections are made, is sufficiently 'distant to prevent all apprehensions. We may also, 'without danger, descend into the first basin; we may 'even go upon the margin of the second, if the rever'beration of the burning matter does not prevent us.

'This was the real state of Vesuvius on the 15th of 'July, 1753. But it perpetually changes its form and 'aspect. It now throws out no stones, and we perceive 'no flame.'

These observations seem to prove, that the seat of the burning in this volcano, and perhaps in all others, is at no great depth in the bowels of the mountain, and that it is not necessary to suppose their fires on a level with, or lower than the sea, and to make their explosions from thence during the time of eruptions. It is sufficient that there are caverns and perpendicular fissures below, or rather at the side of the fire, which serve as ventilators to the furnace of the volcano.

M. de la Condamine, who has had more opportunities than any other philosopher, of examining a number of volcanoes in the Cordeliers, has likewise explored that of Vesuvius, and all the adjacent territories.

'In the month of June, 1755,' he remarks, 'the 'summit of Vesuvius formed an open funnel in a mass 'of ashes, calcarious stones, and sulphur, which burned 'at different distances, and tinged the surface with its 'colour. The fire streamed through different crevices, 'in which the heat was so great, that, in a short time, 'it inflamed a stick thrust some feet down these fissures.

'For several years past, the eruptions of this volcano 'have been frequent; and every time flames and liquid 'matter were thrown out, the mountain underwent con'siderable changes both in its height and external figure. 'In a small plain, on the side of the mountain composed 'of ashes and stones projected from the volcano, there 'is a breast of steep semicircular rocks of two hundred 'feet high, which bound this plain on the north. We 'perceived, near the crevices recently opened in the 'flanks of the mountain, the places through which the 'torrents of lava, with which the whole of this valley is 'filled, had issued during the last eruption.

'This spectacle presents the appearance of metallic 'waves cooled and congealed. We may form an im'perfect idea of it by imagining a sea of thick and tena'cious matter, the waves of which had begun to calm. 'This sea has its islands: they are detached masses, 'like hollow spongy rocks, whimsically interspersed 'with vaults and grottos, under which the burning 'liquid had made a kind of reservoirs resembling fur'naces. From these grottos, with their vaults and pillars, 'hang numbers of scoriæ in the form of irregular grapes 'of all shades and colours.

'All the mountains and coasts in the environs of 'Naples are nothing but masses of burnt matter thrown 'out by volcanoes which now no longer exist, and whose 'eruptions, which have been anterior to all history, 'probably formed the ports of Naples and Puzzoli. The 'same matters are conspicuous on the whole road 'from Naples to Rome, and even at the port of Rome 'itself.

'The whole interior part of Mount Frascati, the chain 'of hills which extends from this place to Grotta-ferrata, 'Castlegandolfo, and as far as lake Albano, a great part 'of Mounts Tivoli, Caprarola, Viterbe, &c. are com'posed of calcined stones, of pure ashes, of scoriæ, of 'matter similar to the dross of iron and burnt earth, 'and of real lava; lastly, the whole matters resemble 'those of which the soil of Portici is composed, and 'which have issued from the sides of Vesuvius in so 'many different forms. Hence we must necessarily 'conclude, that all this part of Italy has been overturned 'by volcanoes.

'Lake Albano, whose margins are interspersed with 'calcined matters, is nothing but the mouth of an 'ancient volcano. The chain of Italian volcanoes ex'tends as far as Sicily, and still exhibits a number of 'fires under different forms; in Tuscany we have the 'exhalations of Firenzuola, and the warm waters of Pisa; 'in the Ecclesiastic state those of Viterbe, of Norcia, 'of Nocera, &c.; in the kingdom of Naples those of 'Ischia, Solfatara, and Vesuvius; in Sicily and the 'islands adjacent to Ætna, the volcanoes of Lipari, 'Stromboli, &c. The other volcanoes of this chain 'have been extinct from time immemorial, and have left 'such relics as, though they do not always strike us at 'first sight, fail not to be recognisable on an attentive 'examination.

'It is very probable,' says M. l'Abbé Mecati, 'that 'in past ages the kingdom of Naples, besides Vesuvius, 'was infested with several other volcanoes.'

'Mount Vesuvius,' le P. de la Torré remarks, 'seems 'to be a portion detached from that chain of mountains 'which, under the name of *Apennines*, divides all Italy 'through its whole length. This volcano is composed 'of three different mountains, one of them is Vesuvius 'properly so called; the other two are Mounts Somma 'and Otajano. The two last are situated towards the 'west, and form a kind of semicircle round Vesuvius, 'with which they have a common base.

'This mountain was formerly surrounded with fertile 'fields, and itself covered with trees and verdure, except 'the summit, which was flat and sterile, and where 'several open caverns were to be seen. The top was 'surrounded with rocks, which rendered it of difficult 'access. These rocks were so high that they concealed 'the valley between Vesuvius and Mounts Somma and 'Otajano. The summit of Vesuvius, which has since 'sunk considerably, being then much more remarkable, 'it is not surprising that the ancients believed it had 'only one top.

'The breadth of the valley is 2220 Paris feet, and its 'length nearly the same. It invests one half of Vesu'vius, and like all the sides of the mountain it is covered 'with burnt sand and small pumice stones. The rocks 'on Mounts Somma and Otajano exhibit a few herbs, 'and the surface of these mountains is covered with 'trees and verdure. These rocks at first sight have the 'appearance of burnt stones; but on a closer examina'tion they are, like the rocks of other mountains, com'posed of strata of natural stones, of a chesnut coloured 'earth, of chalk, and of white stones, which have not 'the smallest appearance of having been liquified by 'fire.

'Round Vesuvius we see openings which have been 'made at different times, and through which lavas had 'issued. These torrents of burning matter, which some'times come from the sides, and sometimes from the 'top of the mountain, descend into the plains, and 'sometimes run as far as the sea, and harden like a 'stone when the matter cools.

'On the summit of Vesuvius there is only a small 'margin of four or five palms wide, and describes a cir'cumference of 5624 Paris feet. Upon this margin we 'can walk pretty commodiously. The whole of it is 'covered with burnt sand, under which we find stones 'partly natural and partly calcined. In two elevations 'on this margin we find beds of natural stones arranged 'in the same manner as in other mountains; which 'confutes the notion of those who regard Vesuvius 'as a mountain gradually raised above the plain of the 'valley.

'The depth of the gulf where the matter boils is about '543 feet; and the height of the mountain above the 'level of the sea is 1677 feet, which is one third of an 'Italian mile.

'This height has been more considerable. The eruptions which have changed the external form of the 'mountain have likewise diminished its elevation; for 'the parts they detached from the summit rolled into 'the gulf.'

From all these examples, if we consider the external figure of Sicily and other countries ravaged by fire, we shall evidently perceive that no volcano exists which is purely isolated or detached. The surface of these countries every where presents a succession and sometimes groups of volcanoes. This we have already seen with regard to Ætna, and shall give a second example of it in Hecla. A great part of the island, like Sicily, is only a group of volcanoes, which I shall prove by the following observations.

The whole island ought to be regarded as a vast mountain interspersed with deep cavities, concealing in its bowels great quantities of minerals, vitrified and bituminous substances, and rising from the midst of the sea in the form of a short flattened cone. Its surface presents to the eye nothing but tops of mountains covered with snow and ice; and lower down we have the picture of confusion and ruin. It is an enormous mass of stones and fragments of rocks, which are sometimes porous and half calcined, and exhibit a hideous appearance by their blackness and the marks of fire impressed upon them. The fissures and hollows of rocks are filled with a red, and sometimes with a black or white sand: but in the valleys between the mountains we find agreeable plains.

Most of Jokuts, which are mountains of a middle height, and overtopped by others of a greater elevation, are volcanoes that occasionally throw out flames, and produce earthquakes: of these there are no less than twenty in this island. The inhabitants in the neighbourhood of these mountains have learned by experience and observation, that when the ice and snow rise to a considerable height, and stop the mouths of these cavities, which formerly discharged flames, earthquakes are about to happen, which are always succeeded by eruptions of fire. It is for this reason that the Icelanders are at present afraid lest the Jokuts, which in the year 1728 threw out flames in the canton of Skaftfield, should soon be again inflamed; the ice and snow being accumulated on their summits, and appearing to obstruct those vents which favoured the exhalations of the subterraneous fires.

In 1721 the Jokut called Koetlegan, about five or six leagues to the west of the sea, near the bay of Portland, broke out into flames, after several successions of the earth. This conflagration melted masses of ice of an enormous thickness, and gave rise to impetuous torrents, which deluged the country, and carried down to the sea prodigious quantities of earth, sand, and stones. The solid masses of ice, and the immense quantity of earth, stones, and sand, transported by the inundation, so loaded the sea, that at half a mile from the coast a small mountain was formed, which still appeared above the sea in the year 1750. We may form some idea of the quantity of matter carried down to the sea by this inundation, when we consider that it was obliged to retreat twelve miles beyond its former limits.

The inundation continued three days; and it was not till after this period that a person could pass on foot to the mountains.

Hecla, which has always been regarded as one of the most famous volcanoes in the universe, on account of its tremendous eruptions, is now one of the least dangerous in the island. Mounts Koetlegan and Krafle have recently made as great ravages as Hecla did of old. It has been remarked, that this last volcano has thrown out flames ten times only in the space of eight hundred years, namely, in the years 1104, 1157, 1222, 1300, 1341, 1362, 1389, 1558, 1636, and lastly, in the year 1693. This eruption commenced on the 13th of February, and continued to the month of August following. All the other eruptions lasted a few months only. From the above dates it appears, that Hecla made its greatest ravages in the fourteenth century, having undergone no less than four eruptions; that it remained perfectly tranquil during the fifteenth century; and that it threw out no fire for one hundred and sixty years. From this period there was one eruption only in the sixteenth, and two in the seventeenth century. We now perceive in this volcano neither fire nor smoke, nor exhalations of any kind. We only find, in some small hollows, as is common in many other parts of the island, boiling water, stones, sand, and ashes.

In 1726, after a few successions of the earth, which were felt only in the northern cantons, Mount Krafle began to throw out, with a dreadful noise, smoke, flames, ashes and stones. This eruption continued two or three years without doing any damage; because the whole rejected matter fell back upon the mountain, or round its base.

In 1728 the fire communicated with some mountains situated near Krafle, which burnt during several weeks. When the minerals they contained were melted, a river of fire ran gently toward the south into the country below these mountains. This river threw itself into a lake about three leagues from Mount Krafle, and by the shock of the water produced a horrible noise and clouds of vapours. The running of the lava did not cease till 1729, when the matter which formed it was probably exhausted. The lake was filled with an immense quantity of calcined stones, which raised its water considerably. It is about twenty leagues in circumference, and situated at an equal distance from the sea. We shall not take notice of the other volcanoes in this island; it is sufficient that we have mentioned the most considerable of them.

From this description we perceive, that the Jokuts of Hecla greatly resemble the secondary volcanoes of Ætna; that in both the highest summit is tranquil; that the summit of Vesuvius is much sunk; and that probably those of Ætna and Hecla were formerly higher than they are at present.

Though the topography of volcanoes in other parts of the world is not so well known as that of those in Europe, we may nevertheless presume from analogy and the similarity of their effects, that they resemble each other in every respect. They are all situated in islands, or upon the coasts of continents. Almost the whole of them are surrounded with secondary volcanoes. Some of them are active, and others extinguished or quiet. The number of the latter is greater, even in the Cordeliers, which appear to be the most ancient domain of volcanoes. In the south of Asia, the islands of Sonde, the Moluccas, and Philippines, bear evident marks of destruction by fire, and are still infested with volcanoes. They are likewise very frequent in the island of Japan: this country is also more subject to earthquakes than any other part of the globe. In many places of Japan there are hot fountains. Most of the Indian islands, and all the seas of these eastern regions, present to our eyes nothing but peaks and detached summits, which vomit out fire, and deep indented coasts, the relicks of ancient continents which are now no more. Here the mariner often meets with ports which daily sink; and even whole islands have been known to disappear, and to be swallowed up with their volcanoes by the waters. The seas in China are warm, which is a proof that there is a great effervescence in the maritime basins of this region. The hurricanes are tremendous, and water-spouts are frequent. The tempests are always preceded by general and perceptible boilings of the waters, and by various meteors and other exhalations with which the atmosphere is loaded.

The volcano of Teneriff has been explored by Dr. Thomas Heberden, who resided several years in the village of Oratava, which is situated at the foot of the Peak. In his way he found large stones disposed on all sides at several leagues from the top of the mountain. Some of them appeared to be entire, and others seemed to have been burnt, and thrown to this distance by the volcano. In ascending the mountain he still saw burnt rocks scattered about in large masses.

'We arrived,' Dr. Heberden remarks, 'at the famous 'grotto of Zegds, which is surrounded on all sides with 'enormous masses of burnt rocks.

'A quarter of a league higher we met with a sandy 'plain, in the middle of which there is a pyramid of 'sand, or yellowish ashes, called the Sugar Loaf. Round 'its base fuliginous vapours perpetually arise. From 'thence to the summit the distance might be half a 'quarter of a league. But the ascent is too difficult, on 'account of its steepness and the bad footing.

'However, we reached what is called the Cauldron, 'which is twelve or fifteen feet deep. Its sides taper to 'the bottom, and form a cavity which resembles a re-'versed cone. Here the ground is very warm; and 'from about twenty tubes or chimneys a thick sulphu-'reous vapour arises. The whole ground seems to be 'mixed with sulphur, which gives the surface a brilliant 'appearance.

'Upon almost all the stones in the neighbourhood 'we perceive a greenish colour, intermixed with yellow 'like gold. A small part of this sugar loaf is as white 'as chalk; and another part still lower resembles red 'clay covered with salt.

'In the middle of another rock we discovered a hole 'which exceeded not two inches in diameter, from 'whence proceeded a noise similar to that of a consi-'derable quantity of water boiling over a great fire.'

The Azores, the Canaries, the islands of Cape Verd, Ascension island, and the Antilles, which appear to be the relicks of ancient continents that united the Old Continent with America offer nothing to our observation but burnt lands, or lands which still continue to burn. The volcanoes formerly sunk under the waters with the countries which supported them, excite such terrible tempests, that in one of these storms which happened at the Azores, the suet fixed to the end of the plumb line melted by the heat at the bottom of the sea.

III.

Of extinguished Volcanoes.

The number of extinguished volcanoes exceed incomparably that of those which are active. They are very numerous in almost every part of the earth. I might mention those remarked by M. de la Condamine in the Cordeliers, and by M. Frenaye in St. Domingo near Port-au-Prince, and those of Japan and the other eastern and southern islands of Asia, the whole of which countries have been formerly ravaged by fire. But I shall limit myself to the extinguished volcanoes of the isles of France and Bourbon, which have been recognised by some enlightened voyagers.

'The soil of the isle of France,' says M. l'Abbé de la Caille, 'is covered with a prodigious number of stones, 'of all sizes, which are of a blackish ash-colour. Many 'of them are full of holes, like a sieve. Most of them 'contain a great quantity of iron; and the surface of the 'earth is covered with the ore of this metal. We like'wise find, especially on the north coast of the island, 'a great many pumice stones, lavas, or refuse of iron, 'profound grottos, and other manifest vestiges of extin'guished volcanoes.

'The isle of Bourbon,' continues M. l'Abbé de la Caille, 'though larger than the isle of France is only a 'large mountain, split as it were from its summit into 'three different parts. Its top is covered with wood, 'and inhabited; and two thirds of its declivity, which 'extends as far as the sea, are cleared and cultivated. 'The rest is covered with the lavas of a volcano, which 'burns slowly and without any noise. It seems not to 'burn much, except during the rainy seasons.

'Ascension island has visibly been formed and burnt 'by a volcano. It is covered with a red earth, similar 'to brick-dust, or burnt clay. The island is composed 'of several mountains from 100 to 150 fathoms high. 'There is one still larger to the south of the island, 'which is about 400 fathoms in height. Its summit is 'double and lengthened: but all the others are pretty 'perfect cones, and covered with red earth. The land 'and part of the mountains are interspersed with prodi'gious quantities of rocks full of holes, like sieves, and 'with very light calcareous stones, a number of which 'resembled coagulated milk; some of them were laid 'over with a dirty white varnish approaching to green. 'Pumice stones are likewise very frequent.'

The celebrated Captain Cook remarks, that in an excursion to the interior parts of Otaheite they found burnt rocks, like those of Madeira; that all the stones bore incontestible marks of fire; that they likewise perceived traces of fire in the clay upon the hills; and that Otaheite and a number of adjacent islands might be supposed to be the relicks of a continent which had been swallowed by the explosions of subterraneous fire. Philip Carteret tells us, that one of the Charlotte islands, situated in the 11° 10′ of south latitude, is of a prodigious height and a conical figure; that its summit is like a funnel, from which smoke issues, but no flames; and that on the most southern coasts of New Britain there are three mountains, from one of which proceeds a large column of smoke.

We find basalts in the isle of Bourbon, where the volcano, though feeble, still acts; in the isle of France, where all the fires are extinct; and in Madagascar, where there are both active and extinguished volcanoes. But to mention no other basalts but those of Europe, we know that there are considerable masses of them in Ireland, in Britain, in Auvergne, upon the borders of the Elbe, in Misnia upon Mount Cattener, at Marienburg, at Weilbourg in the county of Nassau, at Lauterback, at Billstein, in several parts of Hesse, in Lusace, in Bohemia, &c. These basalts are most beautiful lavas produced in all these countries by volcanoes which are now extinct. But we shall content ourselves with abridged descriptions of the extinguished volcanoes in France.

'The mountains of Auvergne,' says M. Guettard, 'which have formerly, in my estimation, been volcanoes, 'are those of Volvic two leagues from Riom, of Puy-de'dome near Clermont, and of Mount Or. The volcano 'of Volvic has formed by its different lavas strata lying 'upon each other, and composing enormous masses, in 'which quarries are dug, and furnish stones to several 'places at a distance. It was at Moulins where I first 'discovered lava, and being at Volvic I perceived that 'the mountain was almost entirely composed of matters 'which had been thrown out by the eruptions of vol'canoes.

'The figure of this mountain is conical, and its base 'consists of rocks of a grayish white granite, or of the 'colour of a pale rose. The rest of the mountain is 'composed entirely of blackish or reddish pumice stone, 'heaped upon each other without order or connection. 'About two thirds up the mountain we meet with 'irregular rocks, bristled with mishapen points turned 'to all sides, and of an obscure red or dirty black. 'They are solid and hard, and have no holes, like the 'pumice stones. Before arriving at the summit we find 'a hole of some fathoms wide, and of a conical figure, 'approaching to that of a funnel. The part of the 'mountain to the north and east appeared to be solely 'composed of pumice stones. In Volvic the beds of 'stone follow the inclination of the mountain, and seem 'to be continued through it, and to communicate with 'those discovered by the ravines a little below the sum'mit. These stones are of an iron gray colour, and 'seem to have a white grain, which comes out on the 'surface like an efflorescence: though spongy, and full 'of small irregular holes, they are hard.

'Mount Puy-de-dome is nothing but a mass of mat'ter which indicates the dreadful effects of the most 'violent fire. In those places of the mountain which 'are not covered with plants and trees, we travel among 'pumice stones, pieces of lava, and a gravel or sand, 'formed by a kind of iron dross and small bits of pumice 'stones mixed with ashes.

'These mountains exhibit several peaks, and all of 'them have cavities or funnels of greater or smaller 'dimensions. One of these peaks, the road which leads 'to it, and the whole space as far as Puy-de-dome, are 'only vast heaps of pumice-stones. The same obser'vation is applicable to the other peaks, which are fif'teen or sixteen in number, situated in the same line 'from south to north, and all of them furnished with 'funnels.

'The top of the peak of Mount Or is a rock composed of a tender whitish ash-coloured stone, similar 'to that on the summits of all the mountains in this 'volcanic country: it is only a little lighter than that 'of Puy-de-dome.

'If I found not on this mountain as many vestiges of 'a volcano as in the other two, it must be partly ascribed 'to this circumstance, that Mount Or is more covered, 'through its whole extent, with trees and shrubs than 'Mounts Volvic and Puy-de-dome. However, the 'south-east part is entirely bare, and entirely composed 'of stones and rocks, which seem to have been exempted from the effects of the fire.

'But the peak of Mount Or is a cone similar to those 'of Volvic and Puy-de-dome. To the east of this point 'is the Peak du Capuchin, which is likewise conical, 'but not so regular as those of the preceding mountains. It even appears that this peak has undergone 'more changes in its structure; for every thing is more 'irregular, and broken into smaller portions. There are 'still several other peaks, the bases of which rest upon 'the ridge of the mountain; but they are all overtopped 'by Mount Or, which is 509 fathoms high. The peak 'of Mount Or is very rugged; it terminates in a point 'about fifteen or twenty feet in diameter.

'There are several conical mountains between Thiers 'and Saint Chaumont, which led me to think,' says M. Guettard, 'that they might have been burnt. Though I 'have never been at Pontgibault, I have sufficient proofs 'to convince me that the mountains of this canton are 'extinguished volcanoes; I have received fragments of 'lava from them, which it was easy to recognise by the 'yellow and blackish points of vitrified matter, which 'are the most certain characteristics of volcanic productions.'

The same M. Guettard and M. Faujas have found, on the left bank of the Rhone, and a good way into the country, very large fragments of basaltic columns. In ascending into the Vivarais they found in a rapid brook a vast collection of volcanic matter, which they followed to its source. It was not difficult to recognise the volcano. It is a very high mountain, on the top of which they found a mouth of about 80 feet in diameter. Below this mouth the lava is partly visible. It has flowed down the ravines in great masses for the space of seven or eight thousand fathoms. The matter has heaped together while yet burning in certain places; and after fixing, it chapped and split through its whole thickness, and left the whole plain covered with innumerable columns, from fifteen to thirty feet long by about seven inches in diameter.

'Having proceeded to Montferrier,' says M. Montet, 'a village about a league distant from Montpelier, I 'found a number of black stones detached from each 'other, and of different figures and sizes. I compared 'them with others which were unquestionably the production of volcanoes, and found them to be of the 'same nature. Hence I no longer doubted that these 'stones of Montferrier were a very hard lava, or a matter melted by a volcano which had long been extinguished. The whole mountain of Montferrier is interspersed with these stones, and the streets are paved 'and the village partly built with them. The surfaces 'of these stones are in general full of holes or porosities, 'which sufficiently indicate that they have been formed 'of matter melted by a volcano. This lava is dispersed 'over all the grounds adjacent to Montferrier.

'On the side of Pezenas extinguished volcanoes are 'very numerous. The whole country is full of them, 'especially from Cap d'Agde, which itself is an extinguished volcano, to the foot of that chain of mountains 'that commences five leagues to the north of this coast, 'and upon their declivity, or at a little distance from 'them, are situated the villages of Livran, Peret, Fontés, 'Nefiez, Gabian, and Faugeres. In going from south 'to north we find a remarkable plinth or chaplet, which 'begins at Cap d'Agde, and comprehends Mounts Saint-Thibery and Causse, (mountains situated in the middle 'of the plains of Bressan,) the peak of Valros in the 'territory of this village, the peak of Montredon in the 'territory of Tourbes, and that of Saint-Marthe, near 'the royal Priory of Cassan. Besides, from the foot of 'the mountain a great and long mass arises, and terminates to the south near the Grange of Prés, and from 'east to west between the village of Caus and that of 'Nisas. It is to be remarked of this canton, that it 'consists of almost nothing but a mass of lava, and 'that in the middle of it there is a round mouth or 'distinct crater about 200 fathoms in diameter, which 'formed a pond that has since been drained by a deep 'cut through the hard lava, which is disposed into 'strata, or rather contiguous undulations.

'In all these places we find lava and pumice stones. 'Almost the whole village of Pezenas is paved with 'lava. The rock of Agde is nothing but a hard lava, 'and the whole of this village is built and paved with 'this lava, which is very black. Almost the whole territory of Gabian, in which is the famous fountain of 'Petroleum, is bestrewed with lava and pumice-stones.

'We likewise find at Causse, Basan, and Saint-Thibery, a considerable quantity of basalts, which are commonly prisms with six sides, and from ten to fourteen 'feet in length. These basalts are found in a place 'where the vestiges of an ancient volcano are no longer 'recognisable.

'The baths of Balaruc every where present us with 'relicks of an extinguished volcano. The stones found 'there are nothing but pumices of different sizes.'

'In all the volcanoes I examined, I remarked, that the matter or stones thrown out are of various figures. Some of them are in large, heavy, and hard masses, like the the rock of Agde: others, like those of Montferrier and the lava of Tourbes, are in detached pieces of considerable weight and hardness.'

M. Villet, of the academy of Marseilles, has transmitted to the king's cabinet some specimens of lava and other matters found in the extinguished volcanoes of Provence; and he writes me, that a league from Toulon there are evident vestiges of an ancient volcano; and that having descended a ravine to the foot of this old volcano of Mount d'Ollioules, he was struck with the appearance of a detached rock which had come down from the mountain. It was calcined; and having broke off some pieces he found in the heart some sulphureous particles so strongly marked, that he no longer doubted the ancient existence of these volcanoes which are now extinct.

M. Valmont de Bomare has observed, in the territory of Cologne, the vestiges of several extinguished volcanoes.

I could give many other examples which all concur in proving, that the number of extinguished volcanoes is perhaps a hundred times greater than that of those now actually existing. I must here remark, that between these two, there are, as in all the other operations of nature, intermediate states, degrees, and shades, of which we can only lay hold of the principal traits. For example, the Solfataras are neither active nor extinguished volcanoes, but seem to participate of both. These no man has better described than one of our learned academicians, M. Fougeroux de Bondaroy; I shall therefore lay before the reader his chief observations.

'Solfatara, situated four miles west from Naples, and two miles from the sea, is surrounded on all sides with mountains. Before arriving at it we must ascend about half an hour. The space comprised between the mountains forms a basin of about 1200 feet in length by 800 feet broad. With regard to the mountains, it lies in a bottom; but it is not so low as the ground you traverse in going to it. The soil in the bottom of the basin is a very fine, close, beaten sand, and it is so dry and parched that it produces no vegetables. The colour of the sand is yellowish. The sulphur, which is found in great quantities among the sand, gives it this colour. The mountains which bound the greatest part of the basin consist of bare rocks, without earth or plants. Some of them are split, and their parts are burnt and calcined; but the whole present no arrangement or order in their position. They are covered with greater or smaller quantities of sulphur, which is sublimed in this part of the mountain and in the neighbouring basin.

'The opposite side consists of a better soil. Neither does it present furnaces similar to those formerly mentioned, and which are common on the other side.

'In several places we find in the bottom of the basin apertures or mouths, from which issues smoke, accompanied with a heat that would burn the hands smartly; but it is not strong enough to kindle paper.

'The adjacent places produce a heat which is felt through the shoes, and a disagreeable odour of sulphur exhales from them. When a sharp pointed stick is thrust into the ground there soon issues a vapour or smoke similar to that which exhales from the natural crevices.

'Through these apertures a small quantity of sulphur is sublimed, together with a salt which has all the characters of sal ammoniac.

'On several stones which surround Solfatara we find threads of alum. Lastly, sulphur is collected from Solfatara. This substance is extracted from grayish stones, interspersed with shining particles, which are sulphur crystallized between the stony particles. These stones are sometimes impregnated with alum.

'By striking the middle of the basin with our foot, we easily perceive that the ground is hollow below.

'If we traverse the side of the mountain, where the mines are most numerous, we find lavas, pumice-stones, the dross of volcanoes, &c. In a word, the whole appearances, when compared with the matters at present furnished by Vesuvius, demonstrate that Solfatara was formerly the mouth of a volcano.

'The basin of Solfatara has often changed its form; and we may conjecture that it will still assume others. This territory daily hollows and undermines itself. It at present forms a vault which covers an abyss. If this vault sinks, the abyss will probably fill with water, and produce a lake.'

M. Fougeroux de Bonderoy has likewise made some observations on Solfataras in other parts of Italy.

'I have been,' says he, 'at the source of a rivulet, which we pass in the road between Rome and Tivoli, the water of which has a strong odour of liver and sulphur. It forms two small lakes about forty fathoms in their greatest extent.

'One of these lakes, according to the plumb-line we were obliged to use, was in different places 60, 70, and 80 fathoms deep. In these lakes we saw several floating islands, which sometimes change their situation. They are composed of plants reduced into a kind of light turf, upon which the waters, though corrosive, have no effect.

'The heat of these waters was 20 degrees, when the thermometer in the open air stood at 18 degrees. Thus it appears from experiment that the heat of these waters is inconsiderable. They exhale a disagreeable odour; and this vapour changes the colour of vegetables and of copper.'

'The Solfatara of Viterbe,' M. l'Abbé Mazeas remarks, 'has a mouth of from three to four feet only. Its waters 'boil, exhale an odour of the liver of sulphur, and pe'trify their canals, like those of Tivoli. The degree of 'their heat is that of boiling water and sometimes more. 'The volumes of smoke, which sometimes arise, indi'cate a still greater heat; and yet the bottom of the 'basin is covered with plants which grow in the bottom 'of the lakes and in the marshes. In ferruginous soils 'these waters produce vitriol,' &c.

'In several of the Apennine mountains, and particu'larly in those on the road from Bologna to Florence 'we find fires or vapours which require only the approach 'of a candle to inflame them.

'The fires of Mount Cenida, near Pietramala, are 'situated at different heights of the mountain, upon 'which we find four mouths that throw out flames. 'One of these fires is in a circular place surrounded with 'a rising ground. Here the earth appears to be burnt, 'and the stones are blacker than those in the neighbour'hood; there likewise issues here and there a lively, 'blue, clear flame, which rises from three to four feet 'high. But beyond this circular space we see no fire, 'though the heat of the ground is perceptible at the 'distance of sixty feet from the centre of these flames.

'Along a fissure or crevice in the neighbourhood of 'the fire we hear a dull noise like that of wind moving 'through a subterraneous passage. Near this place we 'find two sources of hot water. The ground in which 'fire has long existed is neither depressed nor elevated. 'Near this fire we see no volcanic stones, nor any mark 'which indicates that fire has ever been thrown out. 'However, some little hills in the neighbourhood have 'every appearance of having been formed, or at least 'changed by volcanoes. In 1767 succussions of an 'earthquake were felt in the environs; but no change 'was produced on the fire, neither was the smoke in'creased or diminished.

'About ten leagues, from Modena, at a place called 'Barigazzo, there are five or six openings, where at 'particular times flames appear, which are extinguished 'by a strong wind: there are likewise vapours which 'inflame by contact with fire. But notwithstanding the 'unequivocal vestiges of extinguished volcanoes which 'subsist in most of these mountains, the fires seen there 'are not new volcanoes forming, because they never 'throw out any volcanic matter.'

Hot waters, as well as the fountains of Petroleum, and other bituminous and oily substances, should be regarded as another shade between extinguished and active volcanoes.. When subterraneous fires exist near strata of coal, they dissolve the coal, and give rise to most sources of bitumen: they likewise occasion the heat of the hot springs which run in their neighbourhood. But these subterraneous fires now burn with tranquillity; and we only recognise their ancient explosions by the substances they have formerly rejected. They ceased to act when the sea retired from them; and, as already remarked, I believe there is no longer any reason to dread the return of these direful explosions, since every observation concurs in showing that the sea will always retire farther and farther.

IV.

Of Lavas and Basalts.

To what we have said on the subject of volcanoes we shall add some remarks on the motion of lavas, and on the time necessary for their cooling and their conversion into vegetable soil.

The lava which runs from the foot of the eminences formed by the matters rejected by the volcano is an impure glass in fusion. It is a tenacious, viscous, and half fluid substance. Hence the torrents of this vitrified matter, when compared to torrents of water, run slowly; and yet they often proceed to great distances. In these torrents of fire, however, there is another movement than what takes place in those of water: this movement tends to elevate the whole running mass, and is produced by the expansive force of the heat in the interior parts of the burning torrent. The external surface cools first; the liquid fire continues to run below; and as heat acts equally on all sides, the fire, which endeavours to escape, elevates the superior parts that are already consolidated, and often forces them to rise perpendicularly. This is the origin of those large masses of lava in the form of rocks, which are found in the course of almost every torrent where the declivity is not great. By the efforts of this internal heat the lava makes frequent explosions; its surface opens, and the liquid matter springs up and forms those masses which we see elevated above the level of the torrent. Le P. de la Torré, I believe, is the first person who observed this internal movement of burning lavas, which is always more violent in proportion to their thickness and the gentleness of the declivity. This effect is common to all matters liquified by fire, and every man may see examples of it in our common founderies. If we observe those large ingots or masses of melted iron, which run in a mould or canal with a very small declivity, we shall perceive that they have a tendency to rise like arches, especially when the stream is very thick. We have formerly shown, by experiments, that the time of consolidation is always proportioned to the thickness of the ingots, and that when their surfaces are hardened the interior parts still continue to be liquid. It is this internal heat which elevates the ingots and makes them blister. If their thickness were greater, there would be produced, as in the torrents of lava, explosions, ruptures in the surface, and perpendicular jets of metallic matter pushed out by the action of the fire inclosed in the interior parts of the ingots. This explication, drawn from the nature of the thing itself, leaves no doubt concerning the origin of those eminences so frequent in valleys and plains, which have been over-run or covered with lava.

[The lava of iron founderies exhibits the same effects. When this vitreous matter runs slowly, and accumulates at the base, we see eminences arise, which are bubbles or concave hemispheres of glass. These bubbles increase when the expansive force is great, and the matter has little fluidity: it then suddenly explodes into a flame, and makes a considerable report. When the liquified matter is sufficiently adhesive to suffer a great dilatation, these superficial bubbles acquire a volume of eight or ten inches in diameter without breaking. When the vitrification is less complete, and the matter is viscous and tenacious, the bubbles are smaller, and in cooling form concave eminences called toad's eyes. What happens in miniature in our founderies is likewise exhibited upon a larger scale in the lavas of volcanoes.

I have not mentioned some particular causes which frequently produce a curvature or swelling in our melted ingots: for example, when the matter is not very fluid, or when the mould is too moist, the ingots bend considerably; because these causes concur in augmenting the effect of the first. Thus the humidity of the ground, on which the torrents of lava descend, and the internal heat, concur in raising the mass, and in producing explosions, which are always accompanied with those jets of matter formerly mentioned.]

When, after descending from the mountain and traversing the fields, the burning lava arrives at the margin of the sea, its course is suddenly interrupted, the torrent advances, and like a powerful enemy makes the water at first retire: but the water, by its immensity, by the resistance of its cold, and by its power of arresting and extinguishing fire, soon consolidates the torrent of burning matter, which can now proceed no farther, but rises up, accumulates new strata, and forms a perpendicular wall, from the top of which the lava falls and applies itself to the face of the wall thus formed. It is this falling and arresting of the burning matter that gives rise to basaltic prisms and their jointed columns. These prisms have generally five, six, or seven sides, sometimes only three or four, and sometimes eight or nine. The basaltic columns are formed by the perpendicular fall of the lava into the sea, whether it falls from high rocks on the shore, or from a wall raised by its own accumulations. In both cases the cold and humidity of the water arrest the burning matter, and consolidate its surfaces the moment it falls; and the successive bundles or masses of lava apply themselves to each other. As the internal heat of these masses tends to dilate them, a reciprocal resistance is created; and the same effect is produced as happens in the swelling of peas, or rather of cylindrical grain, when squeezed in a close vessel filled with boiling water. Each of these grains would assume an hexagonal figure by reciprocal compression. In the same manner each bundle or mass of lava assumes several sides by dilatation and reciprocal resistance; and when the resistance of the surrounding bundles is stronger than the dilatation of the bundle surrounded, instead of becoming hexagonal, it has only three, four, or five sides. But if the dilatation of the surrounded bundle is stronger than the resistance of the surrounding bundles, it assumes seven, eight, or nine sides, which are always longitudinal.

The transverse articulations of these prismatic columns are produced by a cause still more simple: the bundles of lava fall not in a regular and continued stream, nor in equal masses. Hence, if there are intervals in the fall of the matter, the superior surface of the forming column being partly consolidated, is hollowed by the weight of the succeeding mass, which then moulds itself into a convex form in the concavity or depression of the first. This is the productive cause of those joints or articulations which appear in the greater part of prismatic columns. But when the lava falls in an uninterrupted stream, then the basaltic column is one continued mass, without any articulations. In the same manner, when by an explosion some detached masses are darted from the torrent of lava, these masses assume a globular or elliptical figure, and are even sometimes twisted like cables. To this simple explication all the forms of basalts and figured lavas may be easily referred.

It is to the rencounter of lava with the waves, and its sudden consolidation, that the origin of those bold coasts which border all the seas at the foot of volcanic mountains is to be ascribed. The ancient ramparts of basalt found in the interior parts of continents show that the sea has been in the neighbourhood of these volcanoes when they had thrown out lava. This is an additional proof of the ancient abode of the waters upon all the lands now inhabited.

The torrents of lava are from a hundred to two and three thousand fathoms broad, and sometimes one hundred and fifty, and even two hundred feet thick: and as we have found by experience, that the time of the cooling of glass is to that of the cooling of iron as 132 to 236, and that the times of their respective consolidation are nearly in the same proportion, it is easy to infer, that to consolidate the thickness of ten feet of glass or lava, 201$\frac{2}{3}\frac{1}{9}$ minutes would be necessary, since it requires 360 minutes to consolidate ten feet thick of iron, consequently it will require 4028 minutes, or 67 hours 8 minutes, to consolidate 200 feet thick of lava: by the same rule we shall find, that 30 days $\frac{17}{24}$, or a month, will be requisite before the surface of this lava of two hundred feet thick be sufficiently cold to admit of being touched. Hence a year will be necessary to cool a lava of two hundred feet thick, so as to admit of being touched without burning at the depth of one foot; and at ten feet deep it will still be so warm, at the end of ten years as not to be tangible; and a hundred will be requisite to cool it to the same degree in the middle of its thickness. Mr. Brydone relates, that more than four years after the lava had flowed, in the year 1766, at the foot of Ætna, it was not perfectly cool. Massa, a Sicilian author worthy of credit, tells us, 'that being at 'Catania eight years after the great eruption in 1669, 'he found that the lava in several places was not en'tirely cool.'

About the end of April 1771, Sir William Hamilton dropt pieces of dry wood into a crevice in the lava at Vesuvius, and they were instantly inflamed: the lava issued from the mountain on the 19th of October 1767, and had no communication with the fire of the volcano. The place where this experiment was made was at least four miles distant from the mouth from which the lava issued. He is firmly persuaded, that many years are necessary to cool a lava of this thickness (about 200 feet.)

I have had no opportunity of making experiments upon consolidation and cooling but with balls of some inches in diameter. The only method of making experiments on a larger scale would be to observe lavas, and to compare the times exhausted in their consolidation and cooling, according to their different thicknesses. I am satisfied that these observations would confirm the law I have established for the cooling of bodies from the state of fusion to the common temperature; and although these new observations are by no means necessary to support my theory, still they would help to fill up that immense gap between a cannon ball and a planet.

It now remains for us to examine the nature of lava, and to show that in time it is converted into fertile earth; which recals the idea of the first conversion of the scoriæ of the primitive glass that covered the whole surface of the globe after its consolidation.

'Under the denomination of lava we comprehend 'not,' says M. de la Condamine, 'all the matter thrown 'out by a volcano, such as ashes, pumice-stones, gravel, 'and sand; but solely those reduced to a liquid state by 'the action of fire, and which by cooling form solid 'masses, whose hardness surpasses that of marble. This 'restriction notwithstanding, many other species of lava 'may be conceived, according to the different degrees of 'fusion in the mixture, the greater or smaller quantity 'of metal, and its greater or lesser intimate union with 'the various matters. Beside many intermediate kinds 'three species are easily distinguishable. The purest 'lava resembles when polished a stone of an obscure 'dirty gray colour. It is smooth, hard, heavy, and 'interspersed with small particles similar to black 'marble and whitish points. It seems to contain me'tallic particles. At first sight it resembles serpentine, 'when the colour of the lava does not tend to green. 'It receives a pretty fine polish, which is more or less 'vivid in different parts. It is made into tables, chim'ney-pieces, &c.

'The coarsest kind of lava is rugged and uneven. It 'resembles the scoriæ or dross of iron. The most com'mon species holds a middle rank between the two ex'tremes: it is that which we every where find in large 'masses upon the sides of Vesuvius and in the adjacent 'fields, where it has run in torrents. In cooling it has 'formed masses similar to ferruginous and rusty rocks, 'which are often many feet thick. These masses are 'frequently interrupted and covered with ashes and 'calcined matter. It is under several alternate strata of 'lava, ashes, and earth, the whole of which forms a 'crust of from 60 to 80 feet thick, that temples, porticos, 'statues, a theatre, and an entire city have been disco'vered.'

M. Fougeroux de Bondaroy remarks, 'that immedi'ately after an eruption of burnt earth or of a kind of 'ashes, Vesuvius generally throws out lava, which runs 'down the fissures or furrows made in the mountain.

'The mineral matter inflamed, melted, and flowing, 'or lava properly so called, issues through cracks or 'crevices with more or less impetuosity, and in greater 'or smaller quantity, according to the violence of the 'eruption. It spreads to a greater or smaller distance, 'according to the degree of fluidity, and the declivity of 'the mountain, which more or less retards its cooling.

'That which now covers a part of the land at the 'foot of the mountain, and which sometimes stretches as 'far as Portici, consists of large heavy masses, bristled with 'points on their upper surface. The surface which rests 'on the ground is flatter: as these pieces lie above each 'other, they have some resemblance to the waves of 'the sea. When the pieces are larger and more nume'rous they assume the figure of rocks.

'In cooling, the lava affects various forms. The most 'common is that of tables or boards of greater or smaller 'dimensions. Some pieces are six, seven, and eight 'feet long. It breaks into this form in cooling and 'consolidating. This is the species of lava which is 'bristled with points.

'The second species resembles great ropes: it is 'always found near the mouth of the volcano, and ap'pears to have been suddenly fixed, and to have rolled 'before it hardened. It is lighter, more brittle, more 'bituminous, and softer, than the first species. By 'breaking it we likewise perceive that its substance is 'not so close and compact.

'At the top of the mountain we find a third species 'of lava, which is brilliant, and composed of threads 'which sometimes cross one another. It is coarse, and 'of a reddish violet colour. Some fragments are sono-'rous, and have the figure of stalactites.

'Lastly, in certain parts of the mountain we find lavas 'of a spherical form, and appear to have been rolled. It 'is easy to perceive how the figures of these lavas might 'be varied by a number of accidental circumstances, &c.'

Matter of every kind enters the composition of lavas. Iron and a small quantity of copper have been extracted from the lava found on the summit of Vesuvius. Some specimens are so impregnated with metallic substances as to preserve the flexibility of metal. I have seen two large tables of lava of two inches thick, which were polished like marble, and bended with their own weight. I have seen others which were bended by a weight, and resumed their horizontal position by their own elasticity.

All lavas when reduced to powder are, like glass, susceptible of being converted by the intervention of water, first into clay, and afterwards, by the mixture of dust and corrupted vegetables, into excellent soil. These facts are apparent from the vast and beautiful forests which surround Ætna, and grow upon a bottom of lava covered with several feet of good earth: the ashes are more quickly converted into earth than the powder of glass or of lava. In the craters of old extinguished volcanoes, as well as on the ancient rivers of lava, we find very fertile soils. Hence the devastations occasioned by volcanoes are limited by time; and as nature is always more disposed to produce than to destroy, she in a few ages repairs the devastations of fire, and restores to the earth its former fertility by the very same materials she had employed for the purposes of destruction.

ADDITIONS *to the Article, Of Caverns*, Vol. I. p. 112.

Of Caverns formed by the Primitive Fire.

IN my theory of the earth I mentioned only two kinds of caverns, the one produced by the fire of volcanoes, and the other by the motion of subterraneous waters. Those two species of caverns are not situated at great depths. They are even new, when compared with those vast cavities which were formed at the time when the globe first assumed its solid form; for at this period all the superficial eminences and hollows, and all the cavities in the interior parts of the earth, especially near the surface, were produced. Several of those caverns produced by the primitive fire, after being supported for some time, have afterwards split by cooling, which diminishes the volume of every kind of matter; these would soon fall in, and by their sinking form basins or reservoirs for the sea, into which the waters, formerly much elevated above this level, ran, and abandoned the lands which they originally covered. It is more than probable, that a certain number of these ancient caverns still subsist in the interior parts of the globe, and by their sinking may produce similar effects, and give rise to new receptacles to the waters. In this case they will partly abandon the basin which they now occupy, and run by their natural propensity into these lower places. For example, we find beds of sea-shells in the Pyrenees 1500 fathoms above the present level of the ocean. Hence it is certain, that the waters, when these shells were formed, rose 1500 fathoms higher than they do at present. But when the caverns which supported the lands that are now on the bed of the Atlantic ocean sunk, the waters which covered the Pyrenees and the whole of Europe would run with rapidity into these reservoirs, and of course leave uncovered all the lands in this part of the world. The same revolution would extend to every other country. The waters appear to have never reached the summits of the highest mountains; because they exhibit no relicks of marine productions, and no sufficient marks of a long abode of the waters. However, as some of the matters of which they are composed, though all of the vitrescent kind, seem to have derived their solidity and consistence from the intervention and cement of water, and as they appear to have been formed, as already remarked, in the masses of sand or glass dust, which formerly lay on the peaks of mountains, but which in the progress of time have been carried down to their bottoms by the rains, we cannot pronounce positively, that the waters of the sea never stood higher than the places where shells are now found: the waters have perhaps stood much higher, even before their temperature permitted the existence of shells. The greatest height reached by the universal ocean is to us unknown. But we know that the waters were elevated from 1500 or 2000 fathoms above their present level; since shells are found in the Pyrennees at 1500 fathoms, and in the Cordeliers at 2000.

If all the peaks of mountains were formed of solid glass, or of other matters immediately produced by fire, it would be unnecessary to have recourse to the abode of the waters, or to any other cause, in order to conceive how they assumed their consistence. But most peaks of mountains seem to be composed of matters, which, though vitrifiable, have acquired their solidity by the intervention of water. We cannot, therefore, determine whether their consistence is solely owing to the primitive fire, or whether the intervention and cement of water were not requisite to complete the operation of fire, and to bestow on these vitrifiable masses the qualities which they possess. Besides, this supposition prevents not the primitive fire, which at first produced the greatest inequalities on the globe, from being the chief cause of those chains of mountains that traverse its surface, and particularly of their cores or nuclei; but the contours of these same mountains have perhaps been disposed and fashioned by the waters at a subsequent period; for it is upon these contours, and at certain heights, that shells and other productions of the sea are found.

To acquire a clear notion of the ancient caverns formed by the primitive fire, we must suppose the globe to be deprived of all its waters, and of all the matters which cover its surface, to the depth of ten or twelve hundred feet. By removing in idea this external bed of earth and water, the globe will present to us the form it possessed about the time of its first consolidation. The whole mass was composed of vitreous rock, or, if you will, of melted glass; and this matter, in cooling and acquiring consistence, produced, like all other melted bodies, eminences, depressions, and cavities, upon the whole surface of the globe. These internal cavities formed by fire, are the primitive caverns, and they are more numerous in the southern than in the northern regions; because the rotatory motion, which elevated the equatorial regions before consolidation, likewise produced the greatest derangement of the matter, and, by retarding the consolidation, would concur with the action of the fire in giving rise to a greater number of inequalities in this than in any other part of the globe. The waters coming from the Poles could not approach those burning regions before they cooled. The vaults which supported these regions having successively fallen in, the surface sunk and broke in a thousand places. For this reason, the greatest inequalities of the globe are found in the equatorial regions: there the primitive caverns are more numerous than in any other part of the earth. They are likewise more profound, *i. e.* perhaps five or six leagues deep; because the matter of the globe, while in a liquid state, was agitated to that depth by the motion of rotation. But all the caverns in high mountains derive not their origin from the operation of primitive fire. Those alone which are deeply situated below the mountains can be ascribed to this cause. The more exterior and more elevated have been formed, as already remarked, by the operation of secondary causes. Hence the globe, deprived of its waters and the matters transported by them, would present to us a surface much more irregular than it appears with the aid of this covering. The great chains of mountains and their peaks and ridges, have not now the appearance of half of their real height. The whole are attached by their bases to a vitrifiable rock, and are of the same nature. Thus we should reckon three species of caverns produced by Nature: the first by the force of the primitive fire; the second by the action of water; and the third by that of subterraneous fires: each of these caverns, though different in their origin, may be distinguished by examining the matters they contain, or by which they are surrounded.

ADDITIONS *to the Article, Of the Effect of Rains, Marshes, Subterraneous Wood and Water,* Vol. I. p. 120.

I.

Of the sinking and derangement of certain Lands.

THE rupture of caverns, and the action of subterraneous fires, are the chief causes of the great revolutions which happen in the earth; but they are often produced by smaller causes. The filtration of the water, by diluting the clay, upon which almost all calcarious mountains rest, has frequently made those mountains incline and tumble down. Of these remarkable events I shall subjoin some examples.

'In the year 1757,' says M. Perronet, 'a part of the 'ground situated about half-way before we arrive at the 'Castle of Croix-fontaine, opened in many places, and 'successively tumbled down. The terrace wall, which 'inclosed this ground, was overturned, and the road, 'which was formerly at the foot of the wall, was obliged 'to be carried to a considerable distance. This ground 'rested upon a base of inclined earth.' This learned and chief engineer of our highways and bridges mentions another accident of the same kind which happened, in the year 1733, at Pardines, near Issoire in Auvergne. The ground, for about 400 fathoms in length by 300 in breadth, descended upon a pretty distant meadow, with all its houses, trees, and herbage. He adds, that considerable portions of ground are sometimes transported either by the rupture of reservoirs of water, or by the sudden melting of snows. In 1757, at the village of Guet, about ten leagues from Grenoble, on the road to Briancon, the whole ground, which lies on a declivity, slipt and descended in an instant towards Drac, which is about a mile distant. The earth split in the village, and the part which moved off was six, eight, and nine feet lower than its former station. This ground was situated on a pretty solid rock, which was inclined to the horizon about forty degrees.

To these examples I shall add another fact, of which I have been a constant witness, and which has cost me a considerable expence. The detached rising ground, upon which the town and old castle of Montbard are situated, is elevated 140 feet above the level of the river, and its most rapid descent is to the north-east. This rising ground is crowned with calcareous rocks, the strata of which, when taken together, are 54 feet thick. They every where rest upon a mass of clay, which, of course, before reaching the level of the river, is 86 feet thick. My garden, which is surrounded with several terraces, is situated on the top of this rising ground. From twenty-five to twenty-six fathoms of the last terrace-wall on the north-east side, where the declivity is greatest, gave way all at once, carrying along the inferior ground, which would have gradually descended to the level of the ground near the river, if its progressive motion had not been prevented by taking down the whole wall. This wall was seven feet thick, and founded on clay. The movement of the earth was very slow: I perceived that it was evidently occasioned by the insinuation of water. All the water which falls upon the platform on the top of this rising ground, penetrates through the fissures of the rocks, and reaches the clay upon which they rest: of this fact we are ascertained by two wells dug from the top of the rock to the clay. All the rain-water, therefore, which falls upon this platform and the adjacent terraces, collect upon the clay where the perpendicular fissures of the rock terminate. The water gives rise to small rills in different places, which are rendered still more apparent by several wells dug below the rocks. Wherever this mass of clay is cut by ditches, we see the water filtrating from above. It is not, therefore, surprising that walls, however solid, should slip upon this first bed of moist clay, if they are not founded much lower, as I have done in rebuilding them. The same thing, however, has happened on the north-west side, where the declivity is gentler, and no rills of water appear. The clay had been removed at the distance of twelve or fifteen feet from a great wall, of eleven feet thick, thirty-five feet high, and twelve fathoms long. This wall is constructed of good materials and has subsisted more than nine hundred years. The cut from which the clay was removed, though not above four or five feet deep, has produced a movement in this immense wall. It declines from the perpendicular about fifteen inches, and I could only prevent its downfall by abutments of seven or eight feet thick, and founded at the depth of fourteen feet.

From these facts I drew the following conclusion, which is not so interesting at present as it would have been in ages that are past, that there is not a castle or fortress situated upon heights which might not be easily tumbled into the plain by a simple cut of ten or twelve feet deep and some fathoms wide. This cut should be made at a small distance from the last wall, and upon that side where the declivity is greatest. This method, of which the ancients never dreamed, would have saved them the operation of battering rams and other engines of war; and even at present might be employed in many cases with advantage. I am convinced by my eyes, that when these walls slipt, if the cut made for rebuilding them had not been speedily filled with strong mason work, the ancient walls, and the two towers that have subsisted in good condition nine hundred years, and one of which is 125 feet high, would have tumbled into the valley, along with the rocks upon which they are founded. As most of our hills composed of calcareous stones rest upon a clayey base, the first strata of which are always more or less moistened with the waters that filtrate through the crevices of the rocks, it appears to be certain, that by exposing these moistened beds to the air by a cut, the whole mass of rocks and earth resting upon the clay would slip, and in a few days tumble into the cut, especially during wet weather. This mode of dismantling a fortress is more simple than any hitherto invented; and experience has convinced me that its success is certain.

II.

Of Turf.

To what I have formerly remarked concerning turf, I shall subjoin the following facts.

In the jurisdiction of Bergues-Saint-Winock, Furnes, and Bourbourg, we find turf at three or four feet below the surface. These beds of turf are generally two feet thick, and are composed of corrupted wood, of entire trees with their branches and leaves, and particularly of filberds which are known by their nuts, and the whole is interlaced with reeds and the roots of plants.

What is the origin of these beds of turf which extend from Bruges through the whole flat country of Flanders as far as the river Aa, between the downs and the high country in the environs of Bergues, &c.? In remote ages, when Flanders was only a vast forest, a sudden inundation of the sea must have deluged the whole country, and in retiring deposited all the trees, wood, and twigs, which it had eradicated and destroyed in this lowest territory of Flanders; and this event must have happened in the month of August or September; because we still find the leaves of trees, as well as nuts on the filberds. This inundation must have taken place long before that province was conquered by Julius Cæsar, since no mention is made of it in the writings of the ancients.

In the bowels of the earth we sometimes find vegetables in a different state from that of common turf. For example, in Mount Gannelon near Compiegne, we find on one side of the mountain quarries of fine stones and the fossil oysters formerly mentioned, and on the other side we meet with a bed of the leaves of all kinds of trees, and also reeds, the whole blended together and inclosed in mud. When these leaves are stirred, we perceive the same musty odour which we feel on the margin of the sea; and these leaves preserve their odour during several years. Besides, the leaves are not destroyed; for we can easily distinguish their species: they are only dry, and slightly united to each other by the mud.

'We distinguish,' M. Guettard remarks, 'two species 'of turf: the one is composed of marine, and the other 'of terrestrial plants. We suppose the first to have 'been formed when the sea covered all those parts of 'the earth which are now inhabited. The second is 'supposed to have been superinduced upon the former 'According to this system, it is imagined that the cur'rents carried the sea-plants into the hollows formed by 'the mountains, which were elevated above the waters, 'and after being tossed about by the waves were depo'sited in the hollows.

'This origin of turf is not impossible: the great 'quantity of sea-plants is sufficient to account for 'the phenomenon. The Dutch even alledge, that the 'goodness of their turf is owing to the bitumen with 'which the sea-water is impregnated, and that they were 'formed by sea-weeds.

'The turf-pits of Villeroy are situated in the valley 'through which the river Essone runs; and part of this 'valley extends from Roissy to Escharcon. It is even 'near Roissy that turfs were first dug. But those near 'Escharcon are the best.

'The meadows where turf is dug are open and bad; 'they are filled with rushes, horse-tail, and other plants 'which grow in bad soils. These meadows are dug to 'the depth of eight or ten feet. Next to the upper 'stratum, there is a bed of turf about a foot thick, and 'impregnated with river and land-shells.

'This bed of turf filled with shells is commonly 'earthy: those which succeed are nearly of the same 'thickness, and are always better as we descend. These 'turfs are of a blackish brown colour, intermixed with 'reeds, rushes, and other plants. We see no shells in 'these beds.

'In masses of turf we sometimes find the stems of 'willows and poplars, and sometimes the roots of these 'and similar trees. On the Escharcon side, an oak was 'discovered at the depth of nine feet. It was black and 'almost corrupted. It crumbled into dust after being 'exposed to the air. Another was found on the Roissy 'side, between the soil and the turf, at the depth of two 'feet. Near Escharcon the horns of a stag were found 'three or four feet below the surface.

'Turfs are perhaps equally abundant in the environs 'of Etampes, as near Villeroy. These turfs contain but 'very little moss. Their colour is a fine black. They 'are heavy, and burn well in an ordinary fire. Good 'charcoal might be made of them.

'The turfs in the neighbourhood of Etampes may be 'considered as a continuation of those of Villeroy. In 'a word, all the meadows adjacent to the river Etampes 'are probably full of turf. The same remark is appli'cable to the meadows through which the river Essone 'runs: these meadows produce the same plants as those 'of Etampes and Villeroy.'

According to this author there are in France a number of places from which turf may be obtained, as at Bourneuille, at Croué, near Beauvais, at Bruneval, in the environs of Peronne, in the diocese of Troyes in Champagne, &c. This combustible substance would be a great resource if it were used in such places as want wood.

There are likewise turfs near Vitry-le-Francois, and in the morass along the Marne. These turfs are good, and contain great quantities of acorn shells. The marsh of Saint-Gon in the environs of Chalons is full of turf, which the inhabitants will soon be obliged to use for want of wood.

III.

Of Subterraneous, Petrified, and Charred Wood.

'In the territories of the Duke of Saxe-Cobourg, which 'lie on the frontiers of Franconia and Saxe, and at some 'leagues from the town of Cobourg, there were found, 'at a small depth, whole trees so completely petrified 'that they were as beautiful and as hard as agates. 'Some specimens of them were given by the Princes of 'Saxe to M. Schoepflin, who transmitted two of them 'to M. de Buffon for the royal cabinet. Vases and other 'beautiful utensils have been made of this petrified 'wood.'—*Lettre de M. Schoepflin.*

Wood in its natural state has likewise been found at great depths. M. du Verny, an officer of artillery, sent me some specimens of it, accompanied with the following letter: 'The town of Fere, in the garrison of which I 'am stationed, on the 15th of August 1753, ordered a 'search to be made for water by means of boring: at '39 feet below the surface they found a bed of marl, 'which they continued to pierce for 121 feet: hence at 'the depth of 160 feet, they found at two different trials 'the augre filled with marl, intermixed with numerous 'fragments of wood, which every person easily recog- 'nised to be oak. I send you two specimens of this 'wood. During the succeeding days' operations they 'continued to find the same marl, but not so much 'mixed with wood, as far as the depth of 210 feet, 'where they ceased to bore.'

'In the territory of Cobourg, which is a branch of 'the house of Saxe, we find,' M. Justin remarks, 'pe- 'trified wood of a prodigious size. In the mountains of 'Misnia entire trees have been dug out of the earth, 'which were converted into very fine agate. The im- 'perial cabinet of Vienna contains many petrifactions of 'this kind. A great log of this wood was sent to the 'same cabinet: the part which had been wood was 'changed into a beautiful agate of a grayish black co- 'lour; and instead of bark the trunk was surrounded 'with a belt of fine white agate.

'The present emperor wished that a method of ascer- 'taining the age of petrifactions might be discovered. 'He ordered his ambassador at Constantinople to ask 'permission to take up from the Danube one of the piles 'of Trajan's bridge, which is some miles below Belgrade. 'This permission being granted, one of the piles was 'drawn up, which it was imagined would have been 'petrified by the water. But after such a lapse of time 'it was discovered that the process of petrifaction had 'made very little progress. Though this pile had re- 'mained in the Danube above 1600 years, the petrifac- 'tion had not proceeded above three quarters of an inch 'and even less. The rest of the wood was very little 'altered, and had only begun to be calcined.

'If a just conclusion with regard to all other petri- 'factions could be drawn from this single fact, nature 'would perhaps require fifty thousand years to change 'trees, of the size of those found petrified in certain 'places, into stones. But in particular situations many 'causes may concur in hastening the process of petri- 'faction.

'At Vienna there is to be seen a petrified log, which 'was brought from the Carpathian mountains in Hun- 'gary. Upon this log the marks of the hatchet, which 'had been made before its petrifaction, are distinctly 'visible: and these marks are so little altered by the 'change the wood has undergone, that we perceive they 'have been made by a small instrument.

'Besides, it appears that petrified wood is not so rare 'as is commonly imagined; and that, to discover it in 'many places requires only the nice eye of a natural- 'ist. Near Mansfield I saw a great quantity of petrified 'oak in a place where many people daily pass, without 'perceiving this phenomenon. Some logs were entirely 'petrified, and in these we distinctly perceived the 'rings formed by the annual growth, the bark, the place 'where they were cut, and all the characters of oak- 'wood.'

M. Clozier, who found different pieces of petrified wood upon the hills in the neighbourhood of Etampes, and particularly on that of Saint-Symphorien, imagined that these fragments might have proceeded from some petrified trunks in the mountains. He therefore caused pits to be dug in a part of the mountain of Saint-Symphorien that had been pointed out to him. After digging several feet deep, he first discovered a petrified root, which led him to the trunk of a tree of the same species.

This root, from its extremity to its junction with the trunk, was, says M. Clozier, five feet in length; there were other five roots, but not equally long.

The middling and small roots were not petrified, or at least their petrifaction was so brittle that they remained in the sand, where the trunk was in the form of powder or ashes. It is reasonable to think, that when the process of petrifaction was communicated to these roots, they had been almost corrupted, and that the ligneous parts of which they were composed, being too much separated by petrifaction, could not acquire the degree of solidity necessary to a genuine petrifaction.

The thickest part of the trunk was near six feet in circumference. Its length was three feet ten inches, and its weight was from five to six hundred pounds. The trunk, as well as the roots, had all the appearance of wood, as the bark, the inner rhind, the solid and corrupted wood, the holes of large and small worms, and even the excrements of these worms. All these parts were petrified, but were not so solid and hard as the ligneous body, which had been perfectly sound when the process of petrifaction commenced. The ligneous body is converted into a real flint of various colours, which strikes fire with steel, and produces, after being struck or rubbed, a very strong smell of sulphur.

This petrified trunk was bedded in a horizontal direction. It was covered with more than four feet of earth, and its root was not above two feet below the surface.

M. l'Abbé Mazeas, who discovered at half a mile from Rome a quarry of petrified wood, expresses himself in the following terms:

'This quarry of petrified wood forms a succession of 'hillocks in the front of Monte-Mario on the other side 'of the Tiber. Of these fragments of wood, irregularly 'heaped upon each other, some have the appearance of 'a hard dry earth, which seems not to be fit for the 'nourishment of vegetables: others are petrified, and 'have the colour, the brilliancy, and the hardness of the 'resin known in the shops by the appellation of *colo- 'phanus*. This petrified wood is found in a soil similar 'to the former, but more moist. Both are perfectly 'well preserved. The whole are reduced by calcination 'into a true earth; and none of them produce alum, 'either by the application of fire, or by combining them 'with the vitriolic acid.'

M. du Monchau, a physician and expert naturalist, has sent me for the royal cabinet a piece of petrified wood with the following historical account:

'The piece of petrified wood, which I have the honour 'of transmitting to you, was found at the depth of more 'than 150 feet below the surface. Last year (1754) 'when digging a pit in quest of coal at Notre-Dame-au 'bois, a village situated between Condé, Saint-Amand, 'Mortagne, and Valenciennes, we found, about 600 'fathoms from Escaut, and after passing three water-'levels, first seven feet of rock or hard stone called '*tourtia* in the language of colliers: afterwards, when 'we arrived at a marshy earth, we found at the depth of '150 feet, as already remarked, the trunk of a tree of 'two feet in diameter, which lay across the pit, and of 'course we were prevented from measuring its length. 'It rested upon a large free-stone; and many pieces 'were cut off from this trunk by the curious. The 'small fragment I have the honour of sending you was 'cut off from a specimen given to M. Laurent, a learned 'mechanic.

'This wood seemed rather to have been converted 'into coal than petrified. How could a tree be sunk 'so deep into the earth? Has the soil in which the 'tree was found been formerly as low? If that is the 'case, how could this soil be augmented 150 feet? 'From whence did all this earth proceed?

'The seven feet of *tourtia* observed by M. Laurent, 'which exists also in all the coal-mines for ten leagues 'round, have, according to the above supposition, been 'produced posterior to this accumulation of earth.

'I leave this matter, Sir, to your decision: you are so 'intimately acquainted with nature, that none of her 'mysteries can be long concealed from you; and I have 'no doubt that you will be able to explain this won-'derful phenomenon.'

M. Fougeroux de Bondaroy, of the Royal Academy of Sciences, relates several facts concerning petrified wood, which merit attention.

'All the fibrous stones,' he remarks, 'which have 'some resemblance to wood, are not petrified wood. 'But there are many others which must be recognised 'as such, especially if we attend to the peculiar organi-'zation of vegetables.

'Facts are not wanting to prove that wood may be 'converted into stone, with as much ease at least as 'several other substances, which incontestibly undergo 'this transmutation. But it is difficult to explain how 'this effect is produced. I hope I may be permitted to 'hazard some conjectures on the subject, which I shall 'endeavour to support by facts and observations.

'We find wood which may be considered as only half 'petrified, and not much heavier than common wood. 'Specimens of this kind are easily divided into plates, 'or even into filaments, like certain corrupted timber. 'Others are more petrified, and have the weight, the 'hardness, and the opacity of free-stone. Others, whose 'petrifaction is still more perfect, admit the same polish 'as marble; while others acquire that of fine oriental 'agates. I have an excellent specimen sent from Mar-'tinico to M. du Hamel, which is converted into a most 'beautiful sardonix. Lastly, we find wood changed into 'slate. Among these specimens there are some which 'have retained the organization of wood so completely, 'that we discover with a lens every appearance exhibited 'in unpetrified wood.

'We have seen some specimens encrusted with a 'sandy iron ore, and others penetrated with a substance 'which, being composed of sulphur and vitriol, makes 'them approach the state of pyrites. Some of them 'are, if we may use the expression, larded with a very 'pure iron ore; and others are traversed by veins of 'very black agate.

'We find pieces of wood, one part of which is con-'verted into a stone, and the other into agate; the part 'converted into stone is tender, but the other has the 'hardness peculiar to precious stones.

'But how should certain pieces, though converted 'into hard agate, preserve the distinct characters of 'organization, as the concentric circles, the insertions, 'the extremities of the tubes destined to transmit the sap, 'the bark, the inner rhind, and the wood? If the vegetable 'substance were entirely destroyed we should only see an 'agate, without any of the organic characters formerly 'mentioned. To preserve this appearance of organization, 'if we suppose that the wood subsists, and that the pores 'alone are filled with petrifying juice, it should appear, that 'the vegetable parts might be extracted from the agate. 'But I could never make any progress in this operation. 'I therefore think, that the specimens in question retain 'no parts which have preserved the nature of wood. To 'give perspicuity to my idea, I beg the reader to recol-'lect, that when a piece of wood is distilled in a retort, 'the coal which remains after distillation is not a sixth 'part of the original weight of the wood. When this 'coal is burnt we obtain only a small quantity of ashes, 'which will still diminish after the lixivial salts are 'abstracted.

'This small quantity of ashes being the only fixed 'part, the chemical analysis proves, that the fixed parts 'of a piece of wood are really very trifling, and that the 'greatest portion of vegetable matter is destructible, and 'may be gradually carried off as the wood corrupts.

'Now, if we consider that the greater part of the 'wood is destroyed, and that what remains is a light 'earth, and easily permeable by the petrifying juice, its 'conversion into stone, agate, or sardonix, will not be 'more difficult to conceive than that of bole, clay, or any 'other earth. The only difference is, that the vegetable 'earth preserves the appearance of organization, and the 'petrifying juice insinuates into its pores, without de'stroying its original characters.'

Some facts and observations remain still to be added. In August 1773, at Montigni-sur-Braine, in the district of Challon and jurisdiction of Auxonne, when digging a copper mine, the workmen, at the depth of 33 feet, found a tree lying on its side; but the species of it could not be discovered. The superior strata seemed to have never been touched by the hand of man; for below the soil there was a bed of eight feet of clay; then ten feet of sand; then a bed of fullers earth about six or seven feet; then another bed of the same mixed with stones; and lastly, a bed of black sand of three feet. The tree was found in the fullers earth. The river Braine is to the east, and not above a gun-shot from this place. It runs in a meadow 80 feet lower than the site of the copper.

M. de Grignon informed me, that on the borders of the Marne, near St. Dizier, there is a bed of pyritous wood, the organization of which is apparent. This bed is situated under a stratum of free-stone, which is covered with a stratum of pyrites, and above the pyrites is a stratum of lime-stone. The bed of pyritous wood lies upon a blackish clay.

He likewise found, in the pits dug for discovering the subterraneous town of Chatelet, instruments of iron with wooden handles. He remarked that this wood was converted into a genuine iron ore of the hematites species. The organization of the wood was not destroyed; but it was brittle, and its whole texture was as close as that of the hematites. These iron instruments with wooden handles had been buried in the earth sixteen or seventeen hundred years. The conversion of the wood into hematites had been effected by the decomposition of the iron, which had gradually filled all the pores of the wood.

IV.

Of Bones sometimes found in the Interior Parts of the Earth.

'In the parish of Haux, which is situated between 'two seas, and about half a league from the port of 'Langoiran, a point of rock of eleven feet high detached 'itself from the coast, which was formerly thirty feet 'high. By its fall it spread over the valley a great 'quantity of animal bones or fragments of bones, some 'of which were petrified. That they are bones is un'questionable; but it is difficult to ascertain the animals 'to which they belong. The greatest number consists 'of teeth; some of them perhaps belong to the ox or 'horse; but, without marking the difference in figure, 'most of them are larger than the teeth of these ani'mals. There are likewise thigh or leg bones, and a 'fragment of a stag or elk's horn. The whole are co'vered with common earth, and situated between two 'strata of rock. We must suppose that the carcasses of 'animals have been thrown into a hollow rock, and after 'the flesh had corrupted, a rock of eleven feet high had 'been formed above them, which would require the ope'ration of many ages.

'The Gentlemen of the Academy of Bourdeaux, who 'examined these bones with philosophical accuracy, dis'covered, that when a number of fragments were put on 'a very brisk fire, they were converted into a fine Tur'quois blue; and that some portions became so hard, 'that when cut by a lapidary they received a fine polish. 'It must also be remarked, that bones which evidently 'belonged to different animals were equally converted 'into Turquois.'

'On the 28th of January 1760,' says M. de Guettard, 'there were found, 160 fathoms above the mineral 'baths, bones included in a rock with a gray surface. 'This rock was neither laminated nor consisted of sepa'rate strata, but was one continued mass of stone.

'After having by means of gun-powder penetrated 'five feet deep into this rock, we found a great number 'of human bones belonging to every part of the body, 'as jaw bones with their teeth, bones of the arms, thighs, 'limbs, ribs, rotulæ, &c. jumbled together in the greatest 'disorder. Entire skulls, or portions of them, chiefly 'prevailed.

'Beside these human bones we met with several frag'ments which could not be ascribed to man. In some 'places they are in continued masses, and in others 'more dispersed.

'When we arrived at the depth of four feet and a 'half we found six human heads in an inclined posi'tion. In five of these heads the occiput with its appen'dages, except the bones of the face, were preserved. 'This occiput was partly encrusted with stone, its cavity 'was filled with stone, and had assumed the same mould 'or figure. In the sixth head the face is entire: it is 'broad in proportion to its length. We easily distin'guish the form of the fleshy cheeks. The eyes are shut, 'pretty long, but narrow. The front is large, and the 'nose very flat, but well formed; the middle line is 'distinguishable. The mouth is well made and shut; 'the upper lip is a little thick in proportion to the 'under. The chin is well proportioned, and the whole 'muscles are strongly marked. The colour of the head 'is reddish, and resembles those of the Tritons feigned 'by painters. Its substance is similar to that of the 'stone in which it was found; it is, properly speaking, 'only the mask of the natural head.'

The above relation was sent by M. le Baron Gaillard.

Lonjumeau to Madame de Boisjourdain, who transmitted it to M. Guettard, with some specimens of the bones. That these bones were really human is a very doubtful point; 'for every appearance in this quarry,' M. de Lonjumeau remarks, 'announces that it has been formed 'of relicks of bodies broken in pieces, and which had been 'long tossed about by the waves of the sea before they 'were collected into one heap. As this mass of bones lies 'horizontally, and has been successively covered with 'stony matter, it is easy to conceive how a mask was 'formed on the faces of those heads, the flesh having 'little time to corrupt, especially when the bodies were 'buried under the water. We may therefore reasonably 'conclude, that these heads were not human. They 'rather seem to be the heads of those fishes whose teeth 'are found in the same parts of the stones along with 'the bones supposed to belong to the human species.

'It appears that the collection of bones in the envi'rons of Aix are similar to those discovered some years 'ago by M. Borda near Dax in Gascony. The teeth 'discovered at Aix, by the description given of them, 'seem to resemble those found at Dax, of which an 'under jaw is still preserved. This jaw unquestionably 'belongs to a large fish. I must therefore conclude, that 'the bones in the quarry of Aix are similar to those 'discovered at Dax; and that these bones, whatever 'they are, should be referred to the skeletons of fishes 'rather than to those of man.

'One of the heads in question was about seven and a 'half inches long by three and some lines broad. Its 'figure is that of an oblong globe, flat at the base, 'thicker at the posterior than the anterior end, and 'divided in the broadest part by seven or eight bands 'from seven to twelve lines wide. Each band is like'wise divided into two equal parts by a slight furrow. 'The bands extend from the base to the summit. Those 'of one side are separated from those of the other by 'another and deeper furrow, which gradually enlarges 'from the anterior to the posterior part.

'From this description we cannot recognise the 'mould of a human head. The bones of man's head are 'not divided into bands. The human head is composed 'of four principal bones, the figures of which appear not 'in the mould above described. It has not an interior 'crest which extends longitudinally from the anterior to 'the posterior part, and divides it into two equal parts, 'which might give rise to the furrow on the superior 'part of the stony mould.

'These considerations induce me to think, that this 'substance is rather the body of a nautilus than a human 'head. There are nautili actually divided into bands or 'bucklers like this mould. They have a channel or fur'row which runs along the whole curvature, and divides 'them into two, from which the stony furrow might 'derive its origin,' &c.

I am persuaded, as well as M. le Baron de Lonjumeau, that these heads never belonged to men, but to animals of the seal kind, to sea-otters, and to sea lions or bears. It is not at Aix or Dax alone, that the heads and bones of these animals are found in rocks and caverns. His Highness the present Prince Margrave of Anspach, who to great affability unites a remarkable taste for knowledge, has been so obliging as to give me, for the Royal Cabinet, a collection of bones from the caverns of Gaillenrente in his Margraviate of Bareith. M. Daubenton has compared these bones with those of the common bear, from which they differ only by being larger. The head and teeth are longer and thicker; and the muzzle is longer and more protuberant than in our largest bears. In this collection, with which this noble prince has enriched our cabinet, there is a head which naturalists have denominated 'the head of M. de Buffon's small seal;' but as we know not the form and structure of the heads of sea lions, bears, and large and small seals, we shall suspend our judgment concerning the animals to which these fossil bones have appertained.

ADDITIONS *to the Article, Of the Changes of Sea into Land,* Vol. I. p. 122.

IN traversing the coasts of France, we perceive that a part of Brittany, Picardy, Flanders, and Lower Normandy, have very recently been deserted by the sea; because through all this extent of country we still find great quantities of oysters and other shells in their natural state. We are certain, from experience, that for a century past the sea has been retiring from the coast of Dunkirk. When the moles of this port were constructing, in the year 1670, the fort of Good Hope, which terminates one of these moles, was built upon piles a great way beyond the low-water mark. But at present the water never advances nearer this fort than 300 fathoms. In 1714, when the new harbour of Mardik was deepening, the moles were likewise carried beyond the low-water mark; but now, when the tide is ebb, there is a dry space of more than 500 fathoms. If the sea continues thus gradually to retire, Dunkirk, like Aiguemortes, will in a few centuries be no longer a sea-port. If the sea has lost ground so considerably in our times, how far must it have retired since the beginning of the world ?

The bare inspection of Saintonge is sufficient to convince us, that it was formerly covered by the sea. The ocean having abandoned these lands, the Charente followed as the waters retired, and formed a river where formerly there was only a great lake or morass. The country of Aunis, which was anciently covered by the sea and stagnant waters, is one of the most recent lands of France. It is even probable that this territory was a morass about the end of the fourteenth century.

It appears therefore that the ocean, during some centuries, has retired many feet from all our coasts ; and if we examine those of the Mediterranean, from Roussillon to Provence, we shall find that this sea has likewise retreated nearly in the same proportion. These facts render it evident, that the circumference of all the coasts of Spain and Portugal, as well as those of France, is greatly extended. The same observation has been made with regard to Sweden, where some philosophers have conjectured, that, in the course of 4000 years, the Baltic, the depth of which exceeds not thirty fathoms, will be totally abandoned by the waters.

If similar observations were made in every country, I am persuaded, that in general the sea would be found to have retired from every coast. The same causes which produced its first retreat and successive sinking, are not absolutely annihilated. In the beginning, the sea was two thousand fathoms above its present level. The immense swellings on the surface of the globe, which first subsided, made the waters sink, at first rapidly, and afterwards in proportion as the more inconsiderable caverns gave way. The sea of course was proportionally depressed ; and as many caverns still exist, which must from time to time sink, either by the action of volcanoes, by the force of water, or by earthquakes; we may with certainty predict, that the ocean will continue to retire, and consequently that the extent of all our continents will be gradually augmented.

FACTS AND ARGUMENTS IN SUPPORT OF THE COUNT DE BUFFON'S EPOCHS OF NATURE.

THE treatise composed by the Count de Buffon, under the title of *Les Epoques de la Nature*, is exceedingly ingenious. It is intended to establish by facts and reasoning his theory of the formation of the planets, (see Vol. i. p. 19). But as his theory, however it may be relished on the continent, is perhaps too fanciful to receive the general approbation of the cool and deliberate Briton, the translator has been advised not to render it into English. Many of the facts, however, are too important to be omitted. Instead of a regular translation, therefore, he shall give a general view only of the positions laid down in this treatise, together with the most interesting facts produced in support of these positions.

The Count de Buffon begins his subject with a preliminary discourse, in which he endeavours to unfold the different changes the terrestrial globe has undergone from its first projection out of the sun to the present time. In this discourse the author observes the following order : 1. He mentions such facts as may lead us to the origin of nature. 2. He marks those monuments which ought to be regarded as the evidences of the first ages. 3. He collects such traditions as may convey some idea of the ages which succeeded. After which, says he, we shall endeavour to connect the whole by analogies, and to form a chain which, from the commencement of time, shall descend to the present days.

FIRST FACT.

The earth is elevated at the Equator and depressed at the poles, in the proportion required by the laws of gravity and of the centrifugal force.

SECOND FACT.

The earth possesses an internal heat, which is proper to itself, and independent of that communicated to it by the rays of the sun.

THIRD FACT.

The heat conveyed to the earth by the sun is very small when compared with the heat proper to the globe ; and this heat transmitted by the sun would not alone be sufficient to support animated nature.

FOURTH FACT.

The materials of which the earth is composed are in general of a vitreous nature, and the whole of them may be converted into glass.

FIFTH FACT.

We find on the whole surface of the earth, and even on the mountains, to the height of 1500 or 2000 fathoms, an immense quantity of shells and other relicks of marine productions.

The first fact, namely, the elevation of the globe at the Equator and its depression at the poles, has been mathematically demonstrated and physically proved by the theory of gravitation, and by experiments with the pendulum. The figure of the earth is precisely the same which a fluid globe revolving round its axis with equal celerity would assume. Hence the matter of which the earth is composed was in a state of fluidity the moment it assumed its form, and this moment happened whenever it began to turn round its own axis. Now, though heat is the general cause of fluidity, since water itself, without heat, would form a solid mass, we have two methods of conceiving the possibility of the primitive fluid state of the earth. The first is the solution of terrestrial matters in water; and the second is their liquefaction by fire. But most of the solid matters of which the earth is composed are not soluble in water; and, at the same time, the quantity of water, in proportion to that of dry and solid matter, is so small, that it is impossible the one could be dissolved by the other. Of course, as this state of fluidity could not be effected by dissolution or maceration in water, this fluidity must have been produced by the operation of fire.

This conclusion assumes a new degree of probability from the second fact, and is rendered certain by the third. The internal heat of the globe, which still subsists partially, and is greater than that afforded by the sun, shews that this primitive fire is not yet nearly dissipated. The surface of the earth is colder than its interior parts. Uncontrovertible and reiterated experiments evince, that the whole mass of the globe has a heat proper to itself, and totally independent of that of the sun. This heat is rendered evident by comparing our winters with our summers; and it is still more palpable when we penetrate into the bowels of the earth. At equal depths, it is invariably the same, and it appears to augment in proportion as we descend.

‘ At no great depth, we perceive a heat which never ‘ varies with the temperature of the atmosphere. We ‘ know, that the liquor of the thermometer remains, ‘ during the whole year, at the same height in the caves ‘ of the Observatory, which exceed not 84 feet or 14 ‘ fathoms below the surface. Hence this point has ‘ been fixed as the mean temperature of our climate. ‘ This heat commonly continues nearly the same from ‘ 14 or 15 to 60, 80, or 100 fathoms, more or less, ac‘cording to circumstances, as we experience in our ‘ mines. Beyond this depth it augments, and sometimes ‘ becomes so great, that the workmen could not support ‘ it, if they were not cooled by fresh air, either from air‘pits, or from falls of water. M. de Gensanne found, ‘ that, in the mines of Giromagny, three leagues from ‘ Befort, when the thermometer was carried 52 fathoms ‘ deep, it stood at 10 degrees, as in the caves of the Ob‘servatory; that, at 106 fathoms, it stood at 10½ de‘grees; that, at 158 fathoms, it mounted to 15½ de‘grees; and that, at 222 fathoms, it rose to 18⅙ de‘grees.’

‘ In proportion as we descend into the bowels of the ‘ earth,’ M. de Gensanne remarks, ‘ we perceive a sen‘sible increase of heat. 1800 feet below the level of ‘ the Rhine, at Huninguen in Alsace, I found, that the ‘ heat was so great as to produce a sensible evaporation ‘ from water. A detail of my experiments on this sub‘ject may be seen in the last edition of that excellent ‘ *Traite de la glace* composed by my deceased illustrious ‘ friend M. Dortous de Mairan.’

‘ All the rich veins of every species of metal,’ says ‘ M. Eller, ‘ are in the perpendicular fissures of the ‘ earth; and the depth of these fissures cannot be as‘certained. In Germany some of them have been traced ‘ above 6000 feet deep. In proportion as the miners ‘ descend, they feel that the temperature of the air be‘comes always hotter.’

Though our deepest mines and pits are inconsiderable excavations; yet the internal heat is more sensibly felt in them than on the surface. We may, therefore, presume that, if we could penetrate still deeper, this heat would increase, and that the parts near the centre of the earth are hotter than those more distant. This internal heat is likewise apparent from the temperature of the ocean, the waters of which, at equal depths, exhibit nearly the same heat as that of the interior parts of the earth. ‘ Having plunged a thermometer,’ M. Marsigli remarks, ‘ into the sea in different places and ‘ at different times, it was found that the temperature ‘ at 10, 20, 30, and 120 fathoms, was equally from ‘ 10 to 10¾ degrees.’ On this subject M. de Mairan judiciously remarks, ‘ that the hottest waters which ‘ are at the greatest depth, must, as being the lightest, ‘ continually ascend above those that are heavier. Hence, ‘ according to Marsigli's observations, the temperature ‘ of this immense body of water must be always nearly ‘ equal, except near the surface, which is exposed to ‘ the impressions of the air, where the water sometimes ‘ freezes before it has time to descend by its own weight ‘ and coolness.’

Besides, it is easy to show, that the fluidity of the ocean ought not, in general, to be ascribed to the powers of the solar rays; since we learn from experience, that the light of the sun does not penetrate the most limpid water above six hundred feet; and, of course, that its heat will not reach above a fourth part of that depth, or one hundred and fifty feet. The late M. Bouguer, a learned astronomer of the Royal Academy of Sciences, found, that when sixteen pieces of common glass were applied to each other, and making a thickness of 9½ lines, the light, in passing through these sixteen pieces of glass, was diminished 247 times. He then placed seventy-four pieces of the same glass, in a tube, and at some distance from each other. When this experiment was made, the sun was 50 degrees above the horizon. A very faint appearance of the sun's disk was still perceptible through these 74 pieces of glass. The persons who attended him could likewise perceive, but with difficulty, a feeble light. But, when other three pieces of glass were added to the seventy-four, none of them could distinguish the smallest vestige of light. Hence, if we suppose eighty pieces of the same glass, we have a thickness which will render it perfectly opaque.

From this analogy between the transparency of glass and water, M. Bouguer found, that to render sea-water, which is the most limpid of all waters, perfectly opaque, a thickness of 256 feet is necessary, provided, by another experiment, the light of a flambeau was diminished in the proportion of 14 to 5 in traversing 115 inches of water contained in a tube of 9 feet 7 inches in length. Hence, according to M. Bouguer, no sensible light can pass deeper than 256 feet in water.

It appears to me, however, that the conclusion drawn by M. Bouguer is very distant from the truth. His experiments should have been made with masses of glass of different thicknesses, and not with separate pieces applied to each other. I am persuaded that the sun's light would penetrate a greater thickness than that of these eighty pieces, which formed a thickness of no more than 47½ lines, or near 4 inches. Now, though these pieces he employed were of common glass, it is certain that a solid mass of the same glass, of four inches thick, would not entirely intercept the light of the sun, especially as I know, by my own experience, that light passes easily through 6 solid inches of white glass. I believe, therefore, that the thicknesses assumed by M. Bouguer should be more than doubled, and that the light of the sun penetrates 600 feet deep into the waters of the ocean; for there is another inaccuracy in M. Bouguer's experiments. He did not make the light of the sun pass through his tube of 9 feet 7 inches long: he employed the light of a flambeau, and thence concluded the diminution to be in the proportion of 14 to 5. But I am persuaded, that, if the light of the sun had been employed, this diminution would not have been so great, especially as the light of a flambeau could only pass obliquely, whilst that of the sun, by passing directly, would have penetrated deeper by its incidence alone, independent of its purity and intensity. Thus, taking all circumstances into consideration, it appears, that to approach the truth as near as possible, we should suppose, that the light of the sun penetrates the sea to the depth of 600 feet and that its heat reaches 150 feet deep. The light and heat must here be understood as sensible degrees only of these qualities.

That the heat of the sun penetrates not above 150 feet deep in the waters of the ocean, I ascertained by analogy derived from an experiment which appears to be decisive. With a lens of 27 inches diameter by six inches thick at the centre, I perceived, that by covering the middle part, the lens burnt only from the circumference as far as four inches thick, and that all the thicker part scarcely produced any heat. I then covered the whole lens, except an inch round the centre, and I found, that after passing this thickness of six inches of glass, the light of the sun had no influence on the thermometer. Hence I am warranted to presume, that this same light, weakened by 150 feet thick of water, would not produce a perceptible degree of heat.

The light proceeding from the moon is unquestionably a reflected light of the sun. This light, however, has no sensible heat, even when the rays are collected into the focus of a burning glass. Neither would the light of the sun have any heat, after passing through a certain depth of water; because it would then be equally feeble as that of the moon. I am therefore persuaded, that, by allowing the rays of the sun to pass through a large tube filled with water, and only 50 feet long, which is no more than a third of the depth I have supposed, this feeble light would produce no effect upon the thermometer, even though the liquor stood at the freezing point. From whence I may conclude, that, though the light of the sun penetrates 600 feet in the waters of the ocean, its heat would not reach one fourth of that depth. All the waters below this point would necessarily freeze, unless there was an internal heat in the earth, which alone can maintain their fluidity. In the same manner, it is proved by experience that the heat of the solar rays penetrates not above 15 or 20 feet deep in the earth, since ice is preserved at these depths during the warmest summers. Hence, it is clear, that, below the basin of the sea, as well as under the superior strata of the earth, there is a perpetual emanation of heat, which supports the fluidity of the waters, and produces the temperature of the earth. In the interior parts of the earth, therefore, a heat exists which is proper to it, and which is totally independent of that communicated by the sun.

We might confirm this general fact by a number of particular ones. Every man has remarked, that the snow melts in all places where the vapours of the interior parts of the earth have a free issue, as over pits, covered acqueducts, vaults, cisterns, &c. while in all other places, where the earth, bound up by the frost, intercepts these vapours, the snow not only remains, but, instead of melting, freezes. This circumstance is alone sufficient to show, that these emanations from the internal parts of the earth have a real and sensible degree of heat.

With regard to the *fourth* fact: after the satisfactory proofs we have given in several articles of our *Theory of the Earth*, it is apparent, that the materials of which this globe is composed are of the nature of glass. This general truth, which we can prove by experience, was not altogether unknown to Leibnitz, a German philosopher, whose name will continue to be an honour to his country.

The basis of minerals, of vegetables, and of animals, consists of vitrifiable matter: for all their *residua* may be ultimately converted into glass. The substances called *refractory* by chymists, and which they consider as not fusible, because they resist the action of their furnaces without being changed into glass, may notwithstanding be vitrified by the more intense heat of burning glasses. Hence all the materials of this globe, at least all those which are known to us, have glass for their basis, and may be ultimately reduced to their primitive state.

We have therefore proved the original liquefaction by fire of the whole mass of this globe, agreeably to the most rigorous rules of logic: 1. *A priori*, by the first fact, namely, the elevation of the earth at the equator, and its depression at the poles. 2. *Ab actu*, by the second and third fact, namely, the internal heat of the globe which still subsists. 3. *A posteriori*, by the fourth fact, which shows the effect of this action of fire, *i. e.* glass in all terrestrial substances.

But though the materials which compose this globe have originally been of a vitreous nature, and may all be reduced to glass, they ought to be distinguished from each other with regard to the different states in which they are found before they are converted into glass by the action of fire. They should in the first place be divided into vitrifiable and calcareous substances. The first undergo no change by fire, unless it be pushed to such a degree of intensity as is sufficient to reduce them to glass; but an inferior degree of heat reduces the others to lime. The quantity of calcareous substances, though very considerable, is small when compared to those which are vitrifiable. The *fifth* fact above laid down proves, that calcareous bodies have been formed at a different period, and by another element; and we evidently perceive, that all the matters which have not been produced by the immediate action of the primitive fire, have been formed by the intervention of water; because they are all composed of shells and other relicks of marine bodies. Under the class of vitrifiable substances are comprehended pure rock, quartz, sand, free-stone, granite, slates, clays, metals, and metallic minerals. These substances form the genuine basis of the globe, and compose its principal and greatest part. The whole of them have been originally produced by the primitive fire. Sand is nothing but glass in powder; slates, dried clays, pure rock, free-stone, and granite, are only vitreous masses, or vitrifiable sand in a concreted form. Flints, crystals, metals, and most other minerals, are only distillations, exudations, or sublimations of the first matters, all of which unfold their primitive origin and their common nature, by their aptitude of being converted into glass.

But calcareous sand and gravel, chalk, brown free-stone, marble, alabaster, calcareous spatha, both opaque and transparent, in a word, every substance which can be converted into lime, do not at first exhibit their original nature. Though, like all the others, they proceed from glass, calcareous bodies have passed through filtres, which have changed their appearance. They have been formed by water. They are composed entirely of madrepores, shells, and other relicks of aquatic animals, which alone are capable of converting fluids into solids, and of transforming the water of the sea into stone. Common marble and other calcareous stones are composed of entire shells and fragments of shells, of madrepores, astroites, &c. all the parts of which are either still evident or easily recognisable. Gravel is nothing but broken fragments of marble and calcareous stones which frost and the action of the air detach from the rocks; and they are equally convertible into lime. Lime may also be made of shells, chalk, and light land-stone. Alabaster, and those marbles which contain alabaster, may be regarded as large stalactites, which are formed at the expence of other marbles and common stones. Calcareous spatha is likewise formed by exudation or distillation from calcareous substances, in the same manner as rock-crystal originates from vitrifiable matters. All this may be proved by inspecting these different substances, and by examining attentively the great monuments of nature.

MONUMENT FIRST.

Shells and other productions of the ocean are found on the surface and in the interior parts of the earth; and all the substances called *calcareous* are composed of the remains of these marine bodies.

MONUMENT SECOND.

In examining those shells and other marine productions found in France, Britain, Germany, and all the other parts of Europe, we discover, that most of the animals to which these remains have belonged are not to be found in the adjacent seas, and that these species either have now no existence, or are to be found only in the southern seas. In the same manner we see, in slates and other substances at great depths, impressions of fishes and plants, none of which belong to our climates, and which either do not exist, or are to be met with in southern climates only.

MONUMENT THIRD.

In Siberia, and other northern regions of Europe and Asia, we find the skeletons, tusks, and bones of elephants, hippopotami, and rhinoceroses, in quantities sufficient to convince us, that these animals, which at present can propagate only in the southern regions, formerly existed and propagated in northern countries; and it has been remarked, that these remains of elephants and other terrestrial animals are found at inconsiderable depths below the surface. But shells and other marine bodies are buried deep in the interior parts of the earth.

MONUMENT FOURTH.

The tusks and bones of elephants, as well as the teeth of the hippopotamus, are found, not only in the northern parts of our continent, but likewise in those of North America, though the species of the elephant and rhinoceros have now no existence in the New World.

MONUMENT FIFTH.

In the middle of continents, and in places most remote from the sea, we find an infinite number of shells, most of which belong to animals actually existing in the southern ocean, and several others have no known representatives; so that their species seem to have been annihilated by causes till now unknown.

By comparing these monuments with the facts, we at once perceive that the time when vitrifiable substances were formed is much more remote than that of the formation of calcareous bodies; and may now distinguish four and even five epochs of the remotest antiquity: the first, when the matter of the globe was in fusion by fire, when the earth assumed its form, and the Equator was elevated and the Poles depressed by its rotatory motion: the second, when this matter consolidated, and formed the great masses of vitrifiable substances: the third, when the sea covered the whole land now inhabited, and nourished shell animals, the remains of which have formed calcareous bodies: the fourth, when the waters which cover our continents retired to their proper basins: a fifth epoch, the indications of which are equally clear as the other four, is the time when the elephant, the hippopotamus, and other southern animals, inhabited the regions of the north. This epoch is evidently posterior to the fourth, since the relicks of terrestrial animals are found near the surface of the earth, whilst those of marine animals are generally, and even in the same places, buried at great depths.

What! will any man maintain, that elephants and other animals now peculiar to the south, have formerly inhabited the regions of the north? This fact, however singular and extraordinary it may appear, is not the less certain. Great quantities of ivory have been and daily are found in Siberia, in Russia, and in other northern countries of Europe and Asia. These tusks of the elephant are found some feet below the earth, or they are exposed by the waters when they break down the banks of rivers. We find these tusks and bones of the elephant in so many places, and in such quantities, that they never could be brought into such cold regions by human power. From incontestible and reiterated proofs we are obliged to acknowledge, that these animals were formerly natives of the north, as they are now of the south. What renders this fact more marvellous and more difficult to explain, we find the remains of those animals, now peculiar to the south of the Old Continent, not only in our northern provinces, but likewise in Canada and other parts of North America. In the royal cabinet there are several tusks and many bones of the elephant, which were found in Siberia. We have other tusks and bones of the same animal which were found in France; as well as teeth of the hippopotamus discovered in America, near the river Ohio. Hence these animals, which cannot subsist in cold countries, have formerly existed in northern climates. Of course the Frozen Zone was at that period equally warm as our Torrid Zone is at present; for it is impossible that the bodily constitution and real habits of these animals, which are the most permanent and invariable things in nature, should so far change as to bestow the temperature of the rain deer upon the elephant. Neither can we suppose that these southern animals, which require much heat for their subsistence, could ever live and multiply in northern regions if the climate were equally cold as it is at present. M. Gmelin, who travelled in Siberia, and there collected many bones of the elephant, supposes that vast inundations in the south had driven the elephants to the north, where they would all perish at once by the rigour of the climate. But this cause is not proportioned to the effect. More ivory perhaps has already been brought from the north than all the elephants of India now existing could furnish. Much more will be discovered when the vast deserts of the north, which are scarcely known, shall be peopled, and the earth cultivated and dug by the hands of man. Besides, it is extremely improbable, that these animals should take the route which is most repugnant to their nature; for if they were pushed by inundations from the south, why did they not rather fly to the east and west? Why did they fly as far as the sixtieth degree of north latitude, when they might have stopped on the road, or turned aside to more fortunate climates? And how is it possible to conceive, that by an inundation from the southern ocean the elephants were chased a thousand leagues into the Old Continent, and more than three thousand into the New? It is impossible that an inundation from the Indian ocean should drive the elephants into Canada, or even into Siberia; and it is equally impossible that they should arrive in such numbers as are indicated by their remains.

Dissatisfied with this explication I imagined that a more plausible one might be given, and which should perfectly correspond with my theory of the earth. But before exhibiting my ideas on this subject, I shall, to prevent mistakes, remark, 1. That the ivory found in

Siberia and in Canada unquestionably belongs to the elephant, and not to the morse or sea-cow, as some voyagers have pretended. In the northern regions we likewise find the fossil ivory of the morse; but it is different from that of the elephant; and they are easily distinguished by comparing their internal texture. The tusks, the grinders, the scapulæ, the thigh-bones, and other bones found in the northern climates, certainly belong to the elephant; it is even impossible to hesitate concerning the identity of the species. The large square teeth discovered in the same northern countries, the grinding side of which resembles the spade painted on cards, have every mark of the dentes molares of the hippopotamus; and those enormous teeth, the grinding side of which is composed of large blunt points or protuberances, have belonged to some terrestrial animal that now no longer exists, like the great volutes called *cornua ammonis*, which at present exist not in the ocean.

2. The bones and tusks of these ancient elephants are every way as large as those of the Indian elephants, to which we have compared them. This a proof that these animals did not inhabit the northern regions from any necessity, since they acquired in that situation their full growth and complete dimensions. Of this fact we may be ascertained by the descriptions and dimensions of them given by M. Daubenton under the article *elephant*. But since that time I have had transmitted to me an entire tusk and some fragments of fossil ivory, the length and breadth of which greatly exceed the tusks of the common elephant. I searched all the shops of the Paris ivory-merchants; but I found no tusk which could be compared to that in my possession. But of a great number I found only one equal to those sent from Siberia, whose circumference at the base is nineteen inches. Ivory which is taken from living elephants, or from recent skeletons found in the forests, is denominated *raw ivory*; and the appellation of *roasted ivory* is given to that extracted from the earth, the quality of which is more or less altered according to the time it has remained under ground, or according to the quality of the earth in which it has been buried. Most tusks which come from the north are still very solid, and very fine works may be made of them. The largest were sent to us by M. de l'Isle, an astronomer, and member of the Royal Academy of Sciences. He collected them in his travels through Siberia. In all the shops of Paris there was not a single tusk of raw ivory which measured nineteen inches in circumference: they were all smaller. This tusk was six feet and an inch in length; and it appears, that those in the royal cabinet, which were found in Siberia, were, when entire, more than six feet and a half. But as their extremities were cut off, we could only make a near guess at their real length.

If we compare the thigh-bones found in the same northern countries, we shall be satisfied that they are at least equally long, and considerably thicker than those of the Indian elephants.

Besides, as formerly remarked, we have made an exact comparison of the bones and tusks sent from Siberia with those of the skeleton of an elephant, and we found that all these bones are evidently the relicks of these animals. The Siberian tusks have not only the figure, but the genuine structure of elephant ivory, which M. Daubenton describes in the following terms.

'When an elephant's tusk is cut transversely, we see, 'at or near the centre, a black point called the *heart*. 'But, if the tusk is cut where it is hollow, there is only 'a round hole in the centre. We perceive crooked lines 'which extend in different directions from the centre to 'the circumference, and, by crossing, form small lozenges. At the circumference, there is commonly a narrow circular band. The crooked lines ramify in proportion as they recede from the centre. Hence the 'size of the lozenges is nearly the same throughout. 'Their sides, or at least their angles, are of a more 'lively colour than the areas, doubtless because their 'substance is more compact. The band at the circumference is composed of straight and transverse fibres, 'which, if prolonged, would terminate in the centre. 'It is the appearance of these lines and points which is 'considered as the grain of the ivory. This grain is 'perceptible in all ivories; but it is more or less distinct 'in different tusks; and, when the grain is sufficiently 'apparent, the ivory gets the name of *large grained*, to 'distinguish it from that whose grain is fine.'

It cannot be supposed that elephants could be transported into Siberia by men; for the state of captivity alone, independent of the rigour of the climate, would have reduced them to a fourth or a third of the dimensions which their remains exhibit. Of this effect we have sufficient proof from the comparison we have made between an entire skeleton of an elephant in the Royal Cabinet, which had lived sixteen years at Versailles, with the tusks of other elephants brought from their native country. This skeleton and these tusks, though of considerable size, are one half smaller than the tusks and skeletons of these which live in freedom in Asia or in Africa; and, at the same time, they are at least two thirds smaller than the bones of the same animals found in Siberia.

3. The great quantities of ivory already discovered by accident in countries nearly desert, and where no man searches for it, show, that it is neither by one nor by several accidents, nor at one and the same time, that some individuals of this species have found their way into the northern regions, but that the species had formerly existed and multiplied there, in the same manner as they now exist and multiply in southern latitudes.

The only question, therefore, which remains to be solved, is, Whether there is or has been a cause that could so change the temperature of the different parts of the globe as to render the northern regions, which are now extremely cold, equally warm as the southern climates?

Some philosophers may imagine that this effect has been produced by the change in the obliquity of the ecliptic; because, at first sight, this change seems to indicate, that, as the inclination of the axis of the globe is not permanent, the earth might formerly revolve round an axis so different from that on which it now turns, as to make Siberia then lie immediately under the equator. Astronomers have observed, that the change in the obliquity of the ecliptic is about 45 seconds in a century. Hence, by supposing this augmentation to be constant and successive, 60 centuries would produce a distance of 45 minutes, and 3600 centuries would produce a change of 45 degrees. Such an alteration would bring back the 60th degree of latitude to the 15th, *i. e.* the country of Siberia, where the elephants formerly existed, to the regions of India, where they still exist and multiply. Now, it may be said, we have only to admit this long lapse of time in order to account for the regular abode of elephants in Siberia: it is 360,000 years ago since the earth revolved round an axis 45 degrees distant from that upon which it turns at present: the 15th degree of latitude was then the 60th, &c.

I answer, that this idea, and the mode of explication which results from it, cannot, upon examination, be supported. The change in the obliquity of the ecliptic is not a constant and successive diminution and augmentation. On the contrary, it is a limited variation, and sometimes on one side and sometimes on the other; and consequently can never produce, on any side, nor in any climate, this difference of 45 degrees of inclination; for the variation in the obliquity of the earth's axis is occasioned by the action of the planets, which alter the situation of the ecliptic, without affecting the equator. To take the strongest of these attractions, which is that of Venus, it would require 126,000 years to make a change of 180 degrees in the ecliptic of that planet, and, of course, to produce an alteration of 6 degrees 47 minutes in the real obliquity of the earth's axis; since 6 degrees 47 minutes are the double of the inclination of the orbit of Venus. In the same manner, the action of Jupiter cannot, in 936,000 years, change the obliquity of the ecliptic above 2 degrees 38 minutes; and still this effect is in part compensated by the preceding. Hence it is impossible that this change in the obliquity of the earth's axis should ever amount to 6 degrees, unless we suppose, that the orbits of all the planets should likewise change; a supposition which we cannot nor ought not to admit, since no cause exists which could produce this effect.

But I am enabled to solve this difficult matter, and to deduce it from an immediate cause. We have already seen, that the terrestrial globe, when it first assumed its form, was in a state of fluidity, and that the water being unable to dissolve terrestrial bodies, this fluidity was a liquefaction occasioned by fire. Now, to pass from this burning and liquified state to a mild and temperate heat, time was necessary. The globe could not at once cool to its present temperature. Thus, during the first ages after its formation, the heat proper to the earth was infinitely greater than that which it received from the sun; since it is still much greater. This immense fire being afterwards gradually dissipated, the polar, like all other climates, underwent successive changes from heat to cold. Of course, a certain time, or rather a long tract of time, existed, during which the northern regions, after having burnt like all others, enjoyed the same heat which at present is felt in the southern climates. Hence these northern countries might and actually have been inhabited by animals now peculiar to the south, and to whom this degree of heat is indispensible. The fact, therefore, instead of being extraordinary, perfectly accords with the other facts, and is no more than a consequence of them. Instead of opposing my theory of the earth, this fact, on the contrary, is an accessory proof of its reality, and confirms the most obscure point I have advanced; *i. e.* when we attempt to look back into that profundity of time when the light of genius is apt to extinguish itself, and when, for want of observations, genius has no aid to lead us to a more remote period.

A sixth epoch, posterior to the other five, is that when the two continents were separated from each other. It is certain, that they were not separated when the elephants lived equally in the north of Europe, Asia, and America; I say, equally; for we find their bones in Siberia, in Russia, and in Canada. Hence the separation of the two continents happened posterior to the abode of these animals in the northern regions. But, as we likewise find the tusks of the elephant in Poland, in Germany, in France, and in Italy, we must conclude, that, in proportion as these northern regions cooled, the elephants retired toward the temperate zone, where the heat of the sun, and the greater thickness of the globe, compensated the loss of the earth's internal heat; and that, in the progress of time, the temperate zone having also become too cold, the elephant gradually migrated to the climates under the Torrid Zone, which alone have longest preserved, by the greater thickness of the globe, a superior degree of internal heat. These are likewise the only climates where this interior heat, united with that of the sun, is still sufficient to support their existence, and to permit them to propagate their species.

Independent of the specimens transmitted from Russia and Siberia, and which are preserved in the royal cabinet there are many others in private collections. Vast numbers of them are to be seen in the museum of Petersburg, as appears from a catalogue printed in the year 1742. There are likewise many of them in the British museum, in that of Copenhagen, and in some other collections in Britain, Germany, and Italy. This northern ivory, like the southern, is used in manufacturing many articles of hardware, &c. Hence the great quantity of the tusks and bones of elephants found in Siberia and Russia can no longer remain a doubtful point.

M. Pallas, a learned naturalist, in his late journey through Siberia, found a great quantity of elephants' bones, and an entire skeleton of a rhinoceros, which was buried a few feet only under the surface of the ground.

'Enormous bones of the elephant were lately discovered at Swijatoki, seventeen versts from Petersburg: 'they were found in a spot which had long been covered 'with water. Hence some prodigious revolution must 'have changed the climate, the productions, and the 'animals in every quarter of the globe. These medals 'of nature prove, that those countries which are now 'desolated by the rigours of intense cold, have formerly 'enjoyed all the advantages of the southern latitudes.'

The discovery of the tusks and skeletons of elephants in Canada is but recent; and I was first informed of them by a letter from the late Mr. Collinson, fellow of the Royal Society of London, of which the following is a translation.

'Mr. George Croghan has assured me, that in the 'course of his travels through the countries bordering 'upon the river Ohio, in the years 1765 and 1766, 'about four miles south-east from this river, and 640 'miles distant from Fort du Quesne or Pittsburgh, he 'saw, in the neighbourhood of a large salt marsh, where 'the wild animals assemble at certain seasons of the 'year, immense bones and teeth. Having carefully examined the place, he discovered in a high bank on the 'side of the marsh a prodigious number of bones, which 'from their figure and magnitude appeared to be the 'bones and tusks of elephants.

'But, Sir, the large grinding teeth which I send you 'were found along with these tusks. There are others 'still larger than these, which seem to indicate, and 'even to demonstrate, that they belong not to elephants. 'How shall we reconcile this paradox? May we not 'suppose that there formerly existed a large animal 'which had the tusks of an elephant and the grinders of 'the hippopotamus? for these large grinders are very 'different from those of the elephant. From the great 'number of tusks and grinders which he saw, Mr. 'Croghan thinks, that there must have been at least 'thirty of these animals buried in this place. Elephants 'however were never known in America; and it is improbable they could be brought there from Asia. The 'impossibility of their living in countries where the 'winters are so rigorous, but where great quantities of 'their bones are found, makes a paradox which your 'great sagacity may perhaps explain.

'Mr. Croghan, in the month of February 1767, sent 'to different persons in London, the bones and teeth 'he had collected in the years 1765 and 1766.

'1. To my Lord Shelburn two large tusks, one of 'which was entire, and near seven feet long: its thickness exceeded not that of a common tusk of an elephant of equal length.

'2. A jaw-bone with two grinders in it, beside several 'enormons separate grinders.

'To Dr. Franklin, 1. Three tusks, one of which was 'about six feet long. It had been broke through the 'middle, which was corrupted, and resembled chalk. 'The others were sound. The end of one of them was 'sharpened to a point, and it consisted of very fine ivory.

'2. A small tusk, about three feet long, and as thick 'as a man's arm, with the depressions made by the 'muscles and tendons, which were of a bright chesnut 'colour, and appeared to be as fresh as if recently taken 'from the head of the animal.

'3. Four grinders, one of the largest of which was 'broader than those I sent you, and had likewise an 'additional row of knobs. All those presented to my 'Lord Shelburn and Dr. Franklin were of the same 'form, and had the same enamel, as the specimens I 'now transmit for your examination.

'Dr. Franklin lately dined with an officer who had 'brought from the same place in the neighbourhood of 'the river Ohio, a tusk which was whiter, more lustrous, 'and more entire than any of the others; and likewise a 'grinder still larger than any of those I have mentioned.'

Extract from a Journal of a Voyage made by Mr. Croghan on the river Ohio, and transmitted to Dr. Franklin in the month of May 1765.

'Having passed the great river Miame, we arrived in 'the evening at the place where the bones of elephants 'are found. It is about 640 miles from Fort Pitt. In 'the morning I went to the large marsh where the wild 'animals assemble at certain times of the year. We 'came to this place by a road beaten with the feet of 'the wild oxen or bisons. It is about four miles south-'east from the river Ohio. We saw a great number of 'bones, some of them scattered about, and others buried 'five or six feet below the surface. We saw them in a 'bank of earth along the side of the road. We found 'two tusks of six feet in length, which we carried to our 'hut, along with other bones and teeth. The following 'year we returned to the same place, in order to procure 'a greater number of tusks and teeth.'

'If M. de Buffon had any queries to make upon this 'subject, I entreated him,' says Mr. Collinson, 'to 'transmit them to me; I shall send them to Mr. Crog'han, a man of integrity and parts, who will be happy 'to answer every question.' This little memoir was subjoined to the letter I have just now quoted, and to which I shall add an extract of what Mr. Collinson formerly wrote me concerning these American bones.

'About a mile and a half from the river Ohio, there 'are six enormous skeletons buried on end, with tusks 'from five to six feet long, and of the same form and 'substance as elephants' tusks. They were thirty inches 'in circumference at the root. They tapered to a point. 'But as they were broken, we could not perceive how 'they were joined to the jaws. A thigh-bone of the 'same animals was found entire. It weighed a hundred 'pounds, and was four and a half feet in length. These 'tusks and thigh-bones show that the animal must have 'been of a prodigious magnitude. These facts have 'been confirmed by Mr. Greenwood, who saw the six 'skeletons in the salt-marsh. In the same place he like'wise found large grinders, which appeared not to belong 'to the elephant, but rather to the hippopotamus. Some 'of these teeth he sent to London, among others two 'which together weighed 9¼ pounds. He says, that the 'jawbone was too heavy to be carried by two men. The 'interval between the orbits of the two eyes was eighteen 'inches. An Englishman, who had been taken prisoner 'by the savages, and conducted to this salt-marsh in 'order to teach them how to make salt by evaporating 'the water, declared, that from a peculiar circumstance 'he remembered to have seen these enormous bones. 'He told us, that three Frenchmen, who were breaking 'nuts, sat upon a single thigh-bone.'

Some time after writing these letters, Mr. Collinson read to the Royal Society of London two short essays on the same subject, in which I found some new facts, which I shall relate, and add elucidations of such things as may require explanation.

'The salt-marsh where the elephants' bones are found 'is about four miles distant from the banks of the river 'Ohio; but it is more than seven hundred miles from the 'nearest coast of the sea. There is a road beaten by 'the wild oxen or bisons, large enough to allow two 'chariots to travel abreast. This road directly leads to 'the great salt-marsh where these animals, as well as 'stags and other species of the deer, assemble at a cer'tain season of the year to lick the earth and drink the 'salt water.

'The elephants' bones are found in a bank of about 'six or seven feet high, which surrounds the marsh. 'There we see teeth and bones which had formerly be'longed to some animals of a prodigious size. Some of 'the tusks are near seven feet in length, and consist 'of excellent ivory; and therefore we cannot entertain 'any doubt that they really belong to the elephant spe'cies. It is singular, however, that among these tusks 'we never meet with a single grinder of an elephant, 'but a vast number of enormous teeth, each of which 'has five or six blunt knobs, and must have belonged 'to some animal of an immense size. These square 'teeth have no resemblance to the grinders of the ele'phant, which are flat, and four or five times broader 'than thick; so that these enormous grinders have no 'resemblance to the teeth of any known animal.'

This last remark of Mr. Collinson is extremely just: these large grinders are totally different from those of the elephant; and by comparing them with the grinders of the hippopotamus, which they resemble by their square figure, we shall perceive that they likewise differ in size, as they are two, three, and even four times more voluminous than the largest teeth of the ancient hippopotami found in Siberia and Canada, though these last teeth are three or four times larger than those of the hippopotami which now exist. All the teeth which I have examined in four heads of these animals preserved in the royal cabinet, have the grinding side hollowed in the form of a card-spade, and those found in Canada and Siberia have the same character, and differ from them in size only. But those enormous teeth with large blunt knobs have always four and sometimes five rows; whilst the largest teeth of the hippopotamus have only three. It seems therefore to be certain, that these large teeth have never belonged either to the elephant or to the hippopotamus: the difference in size, though enormous, would not prevent us from regarding them as pertaining to this last species, if all the characters in their form were the same; since we know, as formerly remarked, other square teeth three or four times larger than those of the present existing hippopotami, and which, having the precise same characters, are unquestionably the teeth of hippopotami that have been three times larger than those whose heads are in the royal cabinet. I meant those large teeth which really belonged to the hippopotamus, when I remarked, that they were equally found in both continents, as well as the tusks of the elephant. It is remarkable, however, that we not only find real tusks of the elephant, and real teeth of the large hippopotamus, in Siberia and Canada, but we likewise find in the same countries those enormous teeth with four rows of large blunt knobs. We may therefore conclude, that this immense animal no longer exists, and that the species is entirely extinct.

M. le Compte de Vergennes, minister and secretary of state, was so obliging as to give me in the year 1770 a large tooth, which weighed eleven pounds four ounces. This immense tooth was discovered in making a ditch in Little Tartary. There were other bones which could not be collected, and among these a thigh-bone, of which one half only was entire, and the cavity of this half contained fifteen Paris pints of water. M. l'Abbé Chappé, of the Academy of Sciences, brought me from Siberia a similar tooth, but smaller, and which weighed only three pounds twelve and a half ounces. Lastly, the largest of those transmitted to me by Mr. Collinson was found, among several others, near the river Ohio in America; and they perfectly resemble other specimens brought from Canada.

From all these facts it is apparent, that independent of the elephant and hippopotamus, whose relicks are equally found in the two continents, another animal common to both has formerly existed, the size of which has greatly exceeded that of the largest elephants; for the square form of these enormous grinders shows, that they were numerous in each jaw; and supposing that there were only six or even four in each side of the jaws, we may form some notion of the magnitude of a head which could contain sixteen grinders, each weighing ten or eleven pounds. The elephant has only four grinders, two on each side. They are flat, and occupy the whole jaw; and these two flat grinders of the elephant surpass by two inches only the breadth of the largest square tooth of the unknown animal, which is double the thickness of those of the elephant. Thus every circumstance leads us to think, that this ancient species, which ought to be regarded as the largest of all terrestrial animals, existed during the first ages only; for an animal much larger than the elephant could not be so concealed in any part of the earth as to remain perfectly unknown. Besides, it is evident, from the figure of these teeth, as well as from the enamel, and the disposition of their roots, that they have no relation to the teeth of the cetaceous tribes; and that they have really belonged to a land-animal whose species made a nearer approach to that of the hippopotamus than to any other.

In the course of his essay Mr. Collinson informs us, that several members of the Royal Society were equally well acquainted with the elephants' tusks daily found in Siberia, upon the banks of the Oby, and other rivers of that country. What system, he adds, can be formed, which will, with any degree of probability, account for those bones of the elephant found in Siberia and in America? He concludes with enumerating the weight and dimensions of all the teeth brought from the salt-marsh near the river Ohio, the largest of which belonged to Captain Ourry, and weighed six pounds and a half.

Mr. Collinson, in his second essay, read before the Royal Society of London, December 10, 1767, remarks, that as one of the tusks found in the salt-marsh was striated or furrowed near the thickest end, he entertained some doubts whether these furrows were peculiar to the elephant species. To satisfy himself on this head he visited the warehouse of a merchant who dealt in all kinds of teeth; and after examining them he discovered that there were as many tusks furrowed as smooth at the thick end; and of course he had no difficulty in pronouncing, that the tusks found in America were in every respect similar to those of the African and Asiatic elephants. But as the large American square teeth have no relation to the grinders of the elephant, he thinks, that they are the remains of some enormous animal which had tusks like an elephant, and grinders peculiar to its own species, their magnitude and form being totally different from those of any known animal.

In the year 1748, M. Fabri, who had made great excursions into the northern parts of Louisiana and the southern regions of Canada, informed me, that he had seen heads and skeletons of an enormous quadruped, called by the savages 'the father of oxen;' and that the thigh-bones of these animals were from five to six feet in length. Some time after, and previous to the year 1767, specimens of these large teeth belonging to the unknown animal, as well as those of the hippopotamus, and bones of the elephant, all found in America, were transmitted to Paris. The number of them is too considerable to leave any doubt that these animals formerly existed in the northern regions of America, as well as in those of Europe and Asia.

But elephants have likewise existed in all the temperate countries of our continent. I mentioned tusks found in Languedoc near Simore, and those discovered in Cominges in Gascony. To these I shall add the largest and finest of the whole, lately sent to the royal cabinet by the Duc de la Rochefoucauld, whose zeal for promoting science is a result of his general knowledge. This excellent specimen he found, along with M. Desmarets of the Academy of Sciences, when viewing the fields in the environs of Rome. This tusk was divided into five fragments, which the Duc de la Rochfoucauld ordered to be collected. One of these fragments was stolen by the porter who had the charge of it, and there remained only four, which were about eight inches in diameter. When laid together these four fragments were seven feet in length; and we learn from M. Desmarets, that the fifth fragment, which was lost, was near three feet long. Hence the total length of the tusk must have been about ten feet. By examining the broken ends, we discovered every character of elephantine ivory; though by being long buried under ground, it has become light and friable, like all other fossil ivories.

M. Tozzetti, a learned Italian naturalist, relates, that there were found, in the valleys of Arno, the bones of elephants and other terrestrial animals in great quantities, scattered here and there in the strata of the earth. We may therefore, he remarks, conclude, that elephants were formerly natives of Europe, and especially of Tuscany.

'We found,' says M. Caliellini, 'about the end of 'November, 1759, in a country estate belonging to the 'Marquis de Petrella, situated at Fusigliano in the ter'ritory of Cortona, a fragment of an elephant's bone 'mostly encrusted with a stony matter. Similar fossil 'bones have formerly been discovered in our environs.

'In the cabinet of M. Galeotto Corazzi there is an'other large portion of a petrified elephant's tusk, which 'was lately found in the neighbourhood of Cortona, at 'a place called la Selva. Having compared these frag'ments with a piece of an elephant's tusk lately brought 'from Asia, we found that the resemblance between 'them was perfect.

'In the month of April last M. l'Abbé Mearini brought 'me an entire jaw-bone of an elephant, which he had 'found in the district of Farneta, a village belonging to 'this diocese. This jaw-bone is mostly petrified, and 'particularly on the two sides, where the stony incrus'tation rises an inch above the surface, and has all the 'hardness of a stone.

'Lastly, I am indebted to M. Muzio Angelicri Alti'cozzi, a gentleman of this town, for a thigh-bone of an 'elephant, which is almost entire. He discovered it in 'one of his country estates called Rota, which is situated 'in the territory of Cortona. This bone is a Florence 'fathom long, and is likewise petrified, particularly in 'the upper extremity, called the head.'

In the same manner, we find in France, and in all the other nations of Europe, skeletons and vertebræ of marine animals, which can only subsist in the most southern seas. The same change of temperature therefore has happened in the various parts of the ocean as well as in those of the land; and this second fact, like the first, as it proceeds from the same cause, confirms the whole.

When we compare those ancient monuments of the first age of animated nature with her actual productions, we evidently perceive that the constituent form of each animal has remained the same, and that there is no alteration in the principal parts of their structure. The type of each species has suffered no change. The internal mould has invariably preserved its form. However long we may suppose the succession of time, whatever number of generations may have passed, the individuals of each kind still exhibit the same forms as those of the first ages, especially in the larger species, whose characters are more fixed, and whose nature is more permanent; for the inferior species have, as formerly remarked, been sensibly affected by the different causes of degeneration. We must, however, remark, with regard to the larger species, such as the elephant and hippopotamus, that by comparing their ancient remains with those of our times, we in general perceive that these animals were then much larger than they are at present. Nature was then in her primitive vigour. The internal heat of the earth bestowed on its productions all the vigour and magnitude of which they were susceptible. The first ages produced giants of every kind. Dwarfs and pigmies succeeded after the earth had cooled; and if, as other monuments seem to indicate, some species of animals, which formerly existed, are now lost, this effect could only be produced because their nature required a greater degree of heat than what is now felt in the Torrid Zone. Those enormous and nearly square grinders with blunt knobs, those large cornua ammonis, of which some are several feet in diameter, and many other fossil fishes and shells, which no longer have any living representatives, existed only in those primitive times when the earth and sea were still warm, and produced and nourished animals to whom this degree of heat was necessary, and who exist not at present, because they have probably perished by cold.

To know all the petrifactions of which there are no living representatives, would require long study and an exact comparison of the various species of petrified bodies, which have been found in the bowels of the earth. This science is still in its infancy. We are certain, however, that there are many of those species, such as the cornua ammonis, ortoceratites, lenticular and numismal stones, belemnites, Judaic stones, anthropomorphites, &c. which cannot be referred to any species now existing. We have seen cornua ammonis of two and three feet in diameter; and we have been assured by men worthy of credit, that a cornua ammonis has been found in Champagne larger than a mill-stone, since it was eight feet in diameter and one foot thick. I had an offer of its being sent to me. But the enormous weight of this mass, which is 8000 pounds, and its great distance from Paris, prevented me from accepting the present. These examples, and others which might be given, are sufficient to show, that many species of shell and crustaceous animals formerly existed in the sea, of which there are now no living representatives. The same observation is applicable to some of the scaly fishes. Most of those found in certain slates have so little resemblance to the fishes with which we are acquainted, that their species cannot be ascertained. Even those in the royal cabinet, which are perfectly preserved in masses of stone, cannot be referred to any of our known species. It appears, therefore, that the sea formerly nourished many genera, whose species no longer exist.

But with regard to terrestrial animals, we have only a single example of a lost species, and it appears to have been the largest, without excepting even the elephant: and since the examples of lost species are more rare in land than in marine animals, it is not probable that the production of the former was posterior to that of the latter.

From these facts and monuments we may perceive six successive epochs in the first ages of nature; six species of duration, the limits of which, though indeterminate, are not the less real; for these epochs are not, like those of civil history, marked by fixed points, or limited by centuries and other portions of time which admit of an exact measurement. They may, however, be compared between themselves, and their relative duration may be estimated by other facts and monuments, which indicate contemporary dates.

After finishing his preliminary discourse, the Count de Buffon proceeds to state the different epochs of Nature, which he divides into seven great periods.

EPOCH FIRST.

When the Earth and Planets first assumed their proper Form.

EPOCH SECOND.

When the fluid matter consolidated, and formed the interior rock of the globe, as well as those great vitrifiable masses which appear on its surface.

EPOCH THIRD.

When the waters covered all the Continents.

EPOCH FOURTH.

When the waters retired, and volcanoes began to act.

EPOCH FIFTH.

When the elephants, and other animals of the south, inhabited the northern regions.

EPOCH SIXTH.

When the Continents were separated from each other.

EPOCH SEVENTH, and last.

When the power of Man assisted the operations of Nature.

These epochs are purely hypothetical, and depend more or less on the notion, that the earth and planets were originally driven from the body of the sun by the impulse of a comet, and, of course, remained long in a state of liquid fire. We shall therefore content ourselves with having barely mentioned them, and proceed to enumerate some facts and positions, which, though applied in support of a fanciful system, are curious, and may be useful.

The Count de Buffon remarks, that the cavities and eminences of the globe have been encrusted, and sometimes filled with metallic substances, which are still found in these situations.

‘ Metallic veins,’ says M. Eller, ‘ are found only in elevated places, in a long chain of mountains. This chain of mountains is always supported by a basis of ‘ hard rock. As long as this rock preserves its conti‑ ‘ nuity, there is no chance of discovering metallic veins. ‘ But, when we meet with crevices or fissures, we then ‘ entertain hopes of finding metal. Mineralogists have ‘ remarked, that, in Germany, the most favourable situa‑ ‘ tion is when the mountains rise gradually, stretch to‑ ‘ ward the south-east, and, after attaining their greatest ‘ elevation, descend gently toward the north west.

‘ It is generally in a rugged rock, the extent of which ‘ is often unlimited, but split into fissures, that metals ‘ are found, sometimes pure, but generally in the state ‘ of ores. These fissures are commonly encrusted with ‘ a white shining substance called *quartz* by the miners: ‘ when heavier, but soft and laminated nearly like chalk, ‘ it receives the denomination of *spar*. It is surrounded, ‘ on the side next the rock, with a kind of slime, which ‘ which seems to nourish these quartzy or sparry earths. ‘ These two coverings serve as a sheath for the vein. ‘ The more perpendicular the vein, the more is to be ‘ expected from it. Whenever the miners find a per‑ ‘ pendicular vein, they say that it will be very productive.

‘ In these fissures and cavities, metals are formed by ‘ a perpetual and pretty strong evaporation. The va‑ ‘ pours which issue from mines show that this evapora‑ ‘ tion is still going on. Fissures which have no exhala‑ ‘ tion are commonly barren of metal. The most certain ‘ proof that the exhaling vapours carry along with them ‘ mineral particles, and apply them to the sides of the ‘ fissures, is that successive encrustation which is appa‑ ‘ rent in the whole circumference of these fissures or ‘ hollows of rocks, till their cavities are completely filled, ‘ and the solid vein is formed. This fact is still farther ‘ confirmed by the tools left in these hollows; and, ‘ several years after, they are found to be encrusted with ‘ metal.

‘ The fissures which furnish the most rich veins of ‘ metal always incline to a perpendicular direction. In ‘ proportion as the miners descend, the temperature of ‘ the air is always warmer; and the exhalations are some‑ ‘ times so abundant, and so noxious, that, in order to ‘ avoid suffocation, the miners are obliged to fly to the ‘ pits or galleries, otherwise they would be instantly de‑ ‘ stroyed by the arsenical and sulphureous particles. ‘ Sulphur and arsenic are commonly found in the four ‘ imperfect, and in all the semimetals, and it is from ‘ these they receive their metallic form.

‘ Gold, and sometimes silver and copper, are the only ‘ metals which are found pure in any quantities. But, ‘ in general, copper, iron, lead, and tin, when taken out ‘ of the veins, are mineralized with sulphur and arsenic. ‘ We know from experience, that metals lose their me‑ ‘ tallic form by degrees of heat proportioned to each ‘ species. This destruction of the metallic form, which ‘ the four imperfect metals undergo, shows that the basis ‘ of metals is an earthy matter; and, as these calces, as

' well as the calcareous and gypseous earths, vitrify by ' the application of a certain degree of heat, we are cer- ' tain that metallic earth belongs to the class of vitrifi- ' able earths.

M. Lehman, a celebrated chymist, is the first person who suspected that metallic substances had a double origin. ' Gold and silver,' he remarks, ' are found in ' masses only in the mountains which have veins, and ' iron is found only in those mountains which have ' regular strata. All the small pieces of gold and silver ' found in the mountains with strata have been detached ' from veins in the superior mountains in the neigh- ' bourhood of the former.

' Gold is never in the form of ore. It is always ' found in a native or virgin state, though it is often ' scattered about in particles so minute, that it cannot ' be distinguished even by the best microscopes. In ' the mountains with strata, no gold, and very little ' silver, are to be found. These two metals belong ex- ' clusively to mountains with veins. Sometimes, how- ' ever, we find silver in small leaves, or under the form ' of hair, in slate. Native copper oftener occurs in slate; ' and this copper is also commonly in the form of threads ' or hair.

' A few years after iron-ores have been taken from ' the earth, they are reproduced. They are not found ' in the mountains with veins, but in those with strata. ' Iron is seldom, if ever, met with in a native state.

' With regard to native tin, it has no existence in ' Nature, and is only produced by the assistance of fire. ' The same remark is applicable to lead, though the ' grains found in Silesia, have been considered as native ' lead.

' Native mercury is found in strata of fat argillaceous ' earth, or in slate.

' The silver ores found in slate are not nearly so rich ' as those found in the mountains with veins. This ' metal is found in beds of slate; and is always in the ' form of minute particles, threads, or ramifications, but ' never appears in large masses. These beds of slate ' must likewise be adjacent to the mountains with veins. ' The silver-ores found in strata are never in a solid or ' compact form. All the other ores, which contain ' much silver, are peculiar to the mountains with veins. ' There is a great deal of silver in the strata of slate; ' and it is also sometimes found in pit-coal.

' Tin is the metal which most rarely appears in strata; ' lead is more common in that situation. We find it ' attached to slate, but never to coal.

' Iron is almost universally diffused, and is found in ' beds under a number of different forms.

' Cinnabar, cobalt, bismuth, and lapis calaminaris, are ' likewise commonly found in beds.

' Pit-coal, jett, amber, and aluminous earth, are pro- ' duced by vegetables, and especially by resinous trees ' which have been buried in the earth, and have been ' more or less decomposed; for we often find, above the ' strata of coal, wood which is not totally decomposed; ' and it is still more decomposed as we descend deeper. ' Slate, which covers coal, is often full of the impres- ' sions of plants, such as ferns, maidenhair, &c. It is ' remarkable, that all these impressions belong to foreign ' plants, and the wood likewise appears to be foreign. ' Amber, which ought to be regarded as a vegetable resin, ' often includes insects, which, when attentively exa- ' mined, belong not to the climate where they now exist. ' Aluminous earth is frequently laminated, and resembles ' wood sometimes more and sometimes less decomposed.

' Sulphur, alum, and sal ammoniac, are found in beds ' formed by volcanoes.

' Petroleum and naphtha indicate a subterraneous ' fire, which produces a distillation from pit-coal. We ' have examples of these subterraneous fires which act ' silently, in the coal strata of Britain and Germany. ' They burn long without any explosion; and it is in ' the neighbourhood of these subterraneous fires that hot ' springs are found.

' The mountains which contain veins include neither ' coal nor bituminous and combustible bodies: these ' substances are found only in the mountains with strata.'

In the second epoch of Nature, the Count de Buffon remarks, ' that, in the northern regions there are moun- ' tains composed entirely of iron.' I mention, says he, by way of example, the iron mines near Taberg in Smoland, a part of the island of Gothland in Sweden. It is the most remarkable of those mines, or rather mountains of iron which have the quality of yielding to the attraction of the load-stone; which proves that they have been formed by the action of fire. The basis of this mountain is a very fine sand. Its height is more than 400 feet, and its circumference about one league. It is composed entirely of a rich ferruginous matter, and we even find in it native iron, which is another proof that it has undergone the action of a violent fire. This ore, when broken, exhibits small shining particles, which sometimes cross each other, and sometimes are arranged like scales. This mine has been wrought above two hundred years.

The ore in this mountain is not disposed in regular beds; neither is the iron every where of equal goodness. Through the whole mountain there are fissures sometimes perpendicular, and sometimes horizontal: these are all filled with sand, which contains no iron. This sand is pure, and of the same species with that on the sea-coast. In this sand, we sometimes find the bones of animals, and the horns of stags, which shows that the sand has been carried thither by the waters, and that the formation of this iron mountain by fire happened before the crevices and the perpendicular and horizontal fissures were filled with sand.

The masses of ore are rolled down from the top of the mountain; but in other mines the minerals must be drawn up from the bowels of the earth. This ore must be broken to pieces, or pounded, before it is put into the furnace, where it is smelted by means of charcoal and calcareous stones.

This hill of iron is situated in an elevated and mountainous district, about eighty leagues from the sea: it seems to have formerly been altogether covered with sand.

We are next informed, that there are mountains of load-stone in some countries, and particularly in those of the north. From the foregoing example we have seen that the iron mountain of Taberg rises 400 feet above the level of the sea. M. Gmelin, in his travels through Siberia, remarks, that in the northern countries of Asia almost all the metallic ores are found on the surface of the earth, whilst in other countries they are buried deep in the interior parts of the earth. This fact, if generally true, is a new proof that metals have been formed by the primitive fire, and that the globe being less thick in the northern regions metals were formed nearer the surface than in the southern countries.

M. Gmelin examined the great mountain of loadstone among the Baschkires in Siberia. This mountain is divided into eight parts by valleys, of which the seventh part produces the best loadstone. The summit of this portion of the mountain consists of a yellowish stone, which seems to partake of the nature of jasper. We there find stones that have the appearance of free-stone, which weigh from two to three thousand pounds; but they all have a magnetic virtue. Though covered with moss, they fail not, at more than the distance of an inch, to attract iron and steel. The sides exposed to the air have the strongest magnetic power, those covered with the earth being much weaker. Those parts which are exposed to the injuries of the air are softer, and consequently less proper for being armed. A large portion of loadstone, of the size above mentioned, is composed of a number of other portions which act in different directions. To work them properly they should be separated in such a manner that the whole portion which includes the virtue of each particular magnet, should preserve its unity: by observing this rule we would probably obtain magnets of an uncommon strength. But as they are cut without any foresight, many portions are of no value, either because they contain little or no magnetic power, or because in a single piece there are two or three magnets united: such portions have indeed a magnetic virtue; but as it is not directed to the same point, a magnet of this kind must be subject to great variations.

The loadstone of this mountain, except what is exposed to the air, is exceedingly hard, spotted with black, and full of little knots or protuberances, consisting of small angular parts, like those often observable on the surface of blood-stone, from which it differs only in colour; but instead of these angular parts, we sometimes perceive a kind of ochrey earth. In general, loadstones with these angular parts have less power than the other kinds. That part of the mountain where the loadstones are found is composed almost entirely of a fine iron ore, which lies in small portions among the loadstones. The whole section of the high part of the mountain contains a similar ore; but in proportion as we descend the metal is more rare. Below the ore of loadstone there are other ferruginous stones, which if melted would produce very little iron. These stones have the colour of metal, and are very heavy. Their interior parts are irregular, and have nearly the appearance of scoriæ. In their surfaces they pretty much resemble loadstones; but they have no magnetic power. Between these stones there are other pieces of rock which appear to be composed of small particles of iron. The stone itself is heavy, but very soft. The interior parts resemble burned matter, and they have little or no magnetic virtue. We likewise meet occasionally with a brown iron ore in beds of an inch thick; but it yields very little metal.

In the mountains of Poias in Siberia there are several other mines of loadstone. Ten leagues off the road which leads from Catharinbourg to Salikamskaia, there is a hill called Galazinski, which is more than twenty fathoms high, and is entirely composed of a loadstone rock. It has the brown colour and the density of iron.

Twenty leagues from Salikamskaia, we find cubical loadstones of a brilliant greenish colour. When pulverised the grains have the appearance of fire. It is worthy of remark, that loadstone is found only in those chains of mountains which stretch from south to north.

In the countries bordering upon Lapland, and on the confines of Bothnia, two leagues distant from Cokluanda, there is an iron-ore, from which very fine loadstones are extracted. ‘We admired,’ says Regnard, ‘the surpris-‘ing effects of this stone, when it remained in its natural ‘situation: it required a great deal of force to obtain ‘pieces of the magnitude we wished; and the large ‘hammer employed remained so fixed to the wedge in ‘the stone that the workman required assistance to dis-‘engage it. I tried the experiment myself; I took a ‘large iron lever, which was so heavy that I could hardly ‘support it; I brought it near the wedge by which it ‘was attracted and supported with an amazing force. I ‘held a mariner's compass in the middle of the hole ‘where the ore lay, and the needle revolved perpetually ‘with an incredible rapidity.’

In Vol. i. p. 11. I remarked, ‘that according to the ‘relation of voyagers the mountains of the north are but ‘small hills when compared to the mountains of the ‘equatorial regions; and that the general movement of ‘the waters produced those large mountains in the Old

‘ Continent, which stretch from east to west, and from ‘ north to south in the New.’

This passage requires explanation, as well as some restrictions. From a thousand observations, it is certain, that shells and other productions of the ocean are found upon the whole surface of the inhabited parts of the earth, and even upon the mountains to a very great height. I advanced, from the authority of Woodward, who first collected facts upon this subject, that shells were likewise found on the tops of the highest mountains. From my own observations, as well as those of others, I know that there are shells in the Alps and Pyrennees at 900, 1000, 1200, and 1500 fathoms above the level of the sea; that they are likewise found in the mountains of Asia; and lastly, in the Cordeliers of America, a bank of shells has lately been discovered at the height of more than 2000 fathoms above the sea.

[M. le Gentil, of the Academy of Sciences, wrote me the following letter in December 1771: ‘ Don Antonia ‘ Ulloa desired me, when departing from Cadiz, to send ‘ him two petrified shells, which in the year 1761 he had ‘ dug out of the mountain that contains the quicksilver ‘ mines. This mountain is in the government of ‘ Ouanca-Velica in Peru. Its southern latitude is from ‘ thirteen to fourteen degrees. At the place where these ‘ shells are found, the mercury stood at 17 inches 1¼ line, ‘ which corresponds to the height of 2222⅓ fathoms ‘ above the level of the sea.

‘ At the top of the mountain, which is far from being ‘ the highest in this canton, the mercury stands at 16½ ‘ inches, which implies a height of 2337⅜ fathoms.

‘ In the town of Ouanca-Velica the mercury stands ‘ at 18 inches 1½ line, which gives a height of 1949 ‘ fathoms.

‘ Don Antonio Ulloa informed me, that he detached ‘ these shells from a very thick bank, the extent of ‘ which he did not know: the shells are of the large ‘ pilgrim or scollop kind.’]

It is therefore certain, that in all the different parts of the world, and even to the height of 1500 or 2000 fathoms above the present level of the sea, the surface of the globe has been covered with the waters, and that they remained long enough for the production and multiplication of shell animals; for the quantity of them is so great, that their spoils often form large banks, which extend many miles in length. They compose a considerable part of the exterior strata of the earth; for calcareous substances, or the spoils of shells, are very common in most countries. But at high points of elevation, *i. e.* above 1500 or 2000 fathoms, the summits of the mountains generally consist of pure rock, granite, and other vitrifiable bodies produced by the primitive fire, which contain no shells, madrepores, or any thing that has a relation to calcareous substances. We may therefore conclude, that the sea has never reached, or at least for a short time only, those most elevated parts of the earth.

To support the testimony of Don Ulloa concerning the shells found in the Cordeliers, we shall add that of Alphonso Barba. He tells us, that in the most mountainous part of Peru there are shells of all sizes, some of them concave, others convex, and the whole finely impressed. Hence America, as well as the other quarters of the globe, has been covered with the waters of the sea. The first observers were probably induced to think that no shells were to be found in the Cordeliers, because most of these mountains, which are the highest on this globe, are either active or extinguished volcanoes, the eruptions of which have covered all the adjacent countries with burned substances: of course all the shells which might have been found there are not only buried, but completely destroyed. It is not therefore surprising that no marine productions have been discovered around these mountains, which either are at present, or have formerly been volcanoes; for the territories which surround these mountains must be composed entirely of ashes, scoriæ, glass, lava, and other burned or vitrified bodies. Thus the notion that the sea never covered the mountains has no other foundation than this circumstance, that on the tops of several of them no shells or other productions of the sea are now to be seen. But as we find in an infinite number of places, and even as high as 1500 or 2000 fathoms, shells and other sea-bodies, it is evident, that there are few ridges of mountains which have not been covered with the ocean; and that the spots where no shells appear only show that the animals which produce them have never dwelt there, or that the motion of the waters has not transported thither marine productions, as it has done in every other part of the globe.

We are next informed, that some fishes and plants can live and vegetate in waters so hot as from 50 to 60 degrees of the thermometer. There are many examples of plants growing in the hottest bath-waters; and M. Sonnerat found fishes in water the heat of which was so great that he durst not plunge his hand into it. ‘ Two ‘ leagues from Calamba,’ says he, ‘ I found in the isle ‘ of Lucon, near the village of Bally, a brook, the water ‘ of which was so hot that Reaumur's thermometer, ‘ when plunged into it, about a league from its source, ‘ stood at the 69th degree. Upon perceiving such a ‘ degree of heat, I imagined, that all the productions of ‘ nature must have been extinguished upon the margin ‘ of this brook. But I was much surprised when I saw ‘ three vigorous shrubs, the roots of which were im‘ mersed in this boiling water, and their branches sur‘ rounded with its vapour. The heat was so great, that, ‘ when the swallows attempted to cross the water, at ‘ seven or eight feet high, they uniformly fell down ‘ dead. One of these shrubs was an *agnus castus*, the other two were a species of broom called *aspalathus*. During my abode in this village, I constantly drank this water after it was cooled. Its taste seemed to be earthy and ferruginous. Several baths are constructed along this brook, and their degrees of heat are proportioned to their distance from its source. When I visited the first bath, my surprise was increased: in this water, which was so hot that I durst not plunge my hand into it, I saw fishes swimming. I used every effort to procure some of them; but their agility, and the want of address in the people, prevented me from succeeding. I examined them in the water; but I could not distinguish their genus, on account of the vapour rising from the water. They had brown scales, and the largest of them were about four inches long. I could not learn how these fishes had got into the baths.’ The testimony of M. Sonnerat is strengthened by that of M. Prevost, who travelled with him into the interior parts of the isle of Lucon. ‘You was right,’ M. Prevost remarks, ‘to communicate to M. de Buffon the observations you collected when we travelled together. You desire me to confirm in writing what surprised us so much in the village of Bally, situated on the margin of the Laguna of Manilla, at *Los-bagnos*. I am sorry I have not a copy of our observations made with Reaumur's thermometer. But I clearly recollect, that the water of the small brook which passed through this village to fall into the lake, made the mercury rise to 66 or 67 degrees, though it was plunged into the water at a league's distance from the source of the brook. The margins of this brook were covered with a very fine green carpet. You cannot have forgot the *agnus castus* we saw in flower, the roots of which were moistened with the water of the brook, and its stem and branches perpetually surrounded with its steams. The curate of the village likewise assured me, that he had seen fishes in this same brook. This fact I cannot certify. But I saw fishes in one of the baths, the heat of which raised the mercury to 48 and 50 degrees.’

I know not whether fishes have ever been found in our hot waters; but it is certain that the bottom of the hottest of them is covered with plants. M. l'Abbé Mazéas informs us, that, in the almost boiling water in the Solfatara of Viterbe, the bottom of the basin is covered with the same plants which grow at the bottoms of lakes and ditches.

Of Giants.

From monuments which still remain, it appears, that gigantic animals of different kinds have formerly existed.

The large teeth with blunt knobs which I formerly described, indicate the existence of an animal, whose magnitude greatly surpassed that of the elephant. But this gigantic species is now entirely annihilated. Other large teeth, the grinding face of which resembles spades on cards, like those of the hippopotamus, and which are four times larger than the teeth of the present hippopotamus, show that there has been a very gigantic species of this animal. The enormous thigh-bones, which far exceed the dimensions of those of our elephants, demonstrate the same thing with regard to the elephant species.

In the year 1772, there was found, near Rome, a petrified head of an ox, which P. Jacquier describes in the following manner. ‘The length of the front between the two horns, is 2 feet 3 inches; the distance between the orbits of the eyes, 14 inches, and that from the superior part of the front to the orbit of the eye one foot six inches; the circumference of the horn at the base, is one foot six inches; the length of the horn four feet; and the distance between the ends of the horns three feet. The internal part of this petrefaction is extremely hard. This head was found at Puzzolani more than 20 feet below the surface of the ground.’ [Gazette de France du 25 Septembre, 1772, *Article de Rome.*]

‘In the year 1768, I saw, in the cathedral of Strasburg, a large horn of an ox suspended by a chain to a pillar near the choir. It appeared to be three times bigger than those of our largest oxen. As it was hung very high, I could not take the exact dimensions, but I judged it to be about 4½ feet long, and from 7 to 8 inches in diameter at the base.’ [Note communicated to M. de Buffon by M. Grignon, Sept. 24, 1777.]

Lionel Waffer relates, that he saw, in Mexico, bones and teeth of a prodigious size: among others, he saw a tooth 3 inches broad and 4 in length. Having consulted the most intelligent people of the country, they concluded that the head could not be less than a yard broad.

It is, perhaps, the same head which Acosta mentions: ‘I saw,’ says he, ‘a grinder which astonished me by its enormous size; for it was as large as a man's fist.’ P. Torquemado, a Franciscan, relates, that he had in his possession a grinder, twice as large as a man's fist, and which weighed two pounds. He adds, that, in the city of Mexico, and in the Convent of St. Augustine, he saw a thigh bone so large, that the individual to which it belonged must have been from 11 to 12 cubits high, *i. e.* 17 or 18 feet; and that the head must have been as big as one of the large pitchers used in Castile for holding wine.

Philippe Hernandés informs us, that there were found, at Tezcaco and Tosuca, several bones of an extraordinary magnitude; and that among these there are grinding teeth five inches broad and ten high, from which he concludes, that the size of the head must have been so enormous that two men could not have embraced it with their arms. Don Lorenzo Boturini Benaduci likewise tells us, that, in New Spain, and particularly in the heights of Santa-fe, and in the territories of Puebla and

Ttlascala, they find enormous bones, and grinders, one of which, preserved in the Royal Cabinet, is a hundred times larger than the largest human teeth.

The author of this Gigantologie Espagnole attributes these enormous teeth and bones to giants of the human species. But, is it credible that men ever existed whose heads were eight or ten feet in circumference? Is it not equally astonishing, that in the species of the hippopotamus or elephant, there have been individuals of this magnitude? We are therefore led to think that these enormous teeth are of the same kind with those lately found in Canada near the river Ohio, which we ascribed to an unknown animal, whose species formerly existed in Tartary, in Siberia, and in Canada, and which extended from the Illionois as far as Mexico. As the Spanish authors mention not that elephants' tusks were found in New Spain along with these grinders, it is probable that a species different from that of the elephant formerly existed there, to which these large grinders belonged, and that this species was diffused as far as Mexico. Besides, the large teeth of the hippopotamus seem to have been anciently known; for St. Augustine tells us, that he saw a grinder so large, that if divided it would have made a hundred teeth of an ordinary man. Fulgosa likewise remarks, that teeth were found in Sicily, each of which weighed three pounds.

John Sommer relates, that he found, between Chatham and Canterbury, at the depth of seventeen feet below the surface of the earth, monstrous bones, some of them entire, and others broken. He likewise found four entire teeth, each of them weighing more than half a pound, and nearly as large as a man's fist. The whole four were grinders, and, except in magnitude, they pretty much resembled human teeth. He farther remarks, that Louis Vives mentions a grinder still larger, which was shewn him for a tooth of St. Christopher. He adds, that Acosta saw in India a similar tooth dug out of the earth, along with several other bones, which, when arranged in proper order, represented a man of a monstrous stature. We might have formed the same idea, says Mr. Sommer, concerning the teeth dug out of the earth near Canterbury, if bones had not been found in the same place, which could not belong to the human species. Several persons who examined these bones, judged them to be the bones and teeth of the hippopotamus. Two of these teeth are engraved in the philosophical transactions, No. 272, fig. 9.

From these facts we may conclude, that most of those large bones found under the surface of the earth belong to the elephant and hippopotamus: but it seems to be certain, that, by comparing the enormous teeth with blunt knobs, with those of the elephant and hippopotamus, they have belonged to an animal much larger than either, and that the species of this prodigious animal no longer exists.

Among the present elephants it is extremely rare to find a tusk of six feet in length. The longest are generally from five to six and a half feet; and, of course, the ancient elephant, which produced a tusk of ten feet long, whose fragments are in our possession, was a gigantic species. The immense thigh bone in the Royal Cabinet confirms the same conclusion.

The same remark is applicable to the species of the hippopotamus. I caused two of the largest grinders to be extracted from the largest head of the hippopotamus in the Royal Cabinet: one of them weighed ten, and the other nine and a half ounces. I then weighed two teeth, the one found in Siberia, and the other in Canada. The first weighed two pounds twelve ounces, and the second two pounds two ounces. Hence these ancient hippopotami were gigantic when compared with those now existing.

The example already given of the enormous petrified head of an ox, found in the environs of Rome, proves, that there have likewise been prodigious giants in this species of quadruped, which we are also enabled to show, by several other monuments of antiquity. In the Royal Cabinet, we have, 1. A fine greenish horn, which is very smooth and well turned, and evidently belongs to the ox. The circumference at the base is 25, and its length 42 inches. Its cavity contains $11\frac{1}{4}$ Paris pints of liquor; 2. The core, or internal bone of an ox's horn, which weighs seven pounds; whilst the largest core of the horns of our oxen exceeds not the weight of one pound: this internal bone was presented to the Royal Cabinet by M. le Comte de Tressan, a man of taste, and a good Natural historian; 3. Two internal bones of an ox's horn attached to a portion of the cranium, were found in beds of turf, at the depth of 25 feet, between Amiens and Abbeville, and transmitted to me for the Royal Cabinet. The whole weighed 17 pounds; and each horn-bone, when separated from the cranium, weighed at least $7\frac{1}{2}$ pounds. I compared the dimensions, as well as the weight of these different bones; that of the largest ox to be found in Paris was only 13 inches long, and 7 in circumference at the base. But, of the two dug out of the earth, the one was 24 inches long, and 12 in circumference at the base, and the other 27 inches in lengh, and 13 in circumference. These facts are more than sufficient to shew, that, in the species of the ox, as well as in those of the hippopotamus and elephant, prodigious giants have formerly existed.

With regard to the human species, individual giants have been produced not only in Asia, but in every climate; for, even in our own days, we see gigantic men in every country. We lately saw a giant who was born in Finland, on the very confines of Lapland. But we are not equally certain, that permanent races, and far less, entire nations of giants, ever existed. However, the testimony of ancient authors, and especially those of Holy Writ, seem clearly to indicate, that races of giants formerly existed in Asia. In the book of Numbers, chap. 13, verse 33, it is said, 'And there we saw giants, 'the sons of Anak, which came of the giants: and we 'were in our own sight as grasshoppers, and so we were 'in their sight.' Though this description may have the appearance of exaggeration, which is common in the oriental style, it is plain that these giants were very large.

In 2 Samuel, chap. 21, verse 20, a giant is mentioned of the race and family of Goliath, who had six fingers and toes on his hands and feet: in the same book there are several other passages which prove the existence and destruction of giants.

In Joshua, chap. 2, verse 22, it is said, that 'there 'was none of the giants of the race of the Anakims left 'in the land of the children of Israel; only in Gaza, in 'Gath, and in Ashdod there remained.'

Philo, St. Cyrillus, and several other authors, seem to think, that the word *giants* means only proud and impious men, and not men of an extraordinary stature. But there is no foundation for this opinion; since the amazing height and strength of these men are often described.

The prophet Amos informs us, that the Lord 'de'stroyed the Amorite, whose height was like the height 'of cedars, and he was strong as the oaks.'

Ogg, king of Bashan, was nine cubits high, and Goliath ten cubits and one palm. Ogg's bed was nine cubits, or thirteen and a half feet long, and four cubits, or six feet, broad. The breast-plate of Goliath weighed 208 pounds 4 ounces, and the blade of his lance 25 pounds.

These evidences are sufficient to prove, that there formerly existed in the continent of Asia, not only individuals, but races of giants, who have been destroyed, and the last of whom appeared in the days of King David. Nature, who never loses any of her rights, sometimes resumes her former powers of production; for in almost every climate men of an extraordinary stature, *i. e.* of seven and and a half, eight, and even nine feet high, occasionally appear. Beside the examples already given, many others are to be found, both in ancient and modern authors, of giants of ten, twelve, fifteen, and eighteen feet high. But these last dimensions, I am persuaded ought to be greatly reduced. The bones of elephants have often been mistaken for human bones. Besides, nature in her present appearance presents no species with such great disproportions, except perhaps that of the hippopotamus; for the teeth of those found in the bowels of the earth are at least four times larger than the teeth of the hippopotamus which now exists.

The bones of the supposed king Teutobochus, found in Dauphiny, gave rise to a dispute between Habicot, a surgeon in Paris, and Riolan, the famous anatomist. Habicot, in his Gigantosteologie, tells us, that these bones were taken out of a brick sepulchre, 18 feet below ground, and surrounded with sand. He neither gives an exact description, nor the number of these bones. He asserts that they are human, because they belonged to no other animal. He adds, that some masons, when working for Seignio Langton, a gentleman of Dauphiny, on the 11th day of January 1613, discovered this tomb near the ruins of the castle of Chaumont; that the tomb was built with brick; that it was 30 feet long, 12 broad, and 8 high; that it was covered with a gray stone, on the middle of which was engraved *Theutobochus rex;* that when the tomb was opened a human skeleton appeared, which was 25½ feet long, 10 broad at the shoulders, and 5 thick; that before touching these bones the head was measured, and it was five feet in length, and 10 in circumference. Here it is worthy of remark, that the proportion between the length of a human head and that of the body is not a fifth, but a seventh and one half; so that this head of 5 feet supposes the body to have been 37½ feet in length. Lastly, Habicot tells us, that the under jaw was 6 feet round, and the orbits of the eyes 7 inches; that each clavicle was 7 feet long; and that most of these bones, after being exposed to the air, crumbled into dust.

In the same year 1613 Dr. Riolan published a tract under the title of Gigantomachie, in which he maintains, that Habicot, in his Gigantosteologie, had given false measures of the body and bones of the pretended giant Teutobochus; that Riolan measured the thigh-bone and the bone of the leg together with the astragalus joined to the calcaneum; that they exceeded not 6½ feet, even including the os pubis; and of course that the length of the giant could be only 13 feet, instead of 25. He then gives his reasons for denying these bones to be human; and concludes, that the bones exhibited by Habicot belong not to man but to the elephant.

A year after the publication of Habicot's Gigantosteologie and Riolan's Gigantomachie, a pamphlet appeared under the title of 'The Imposture concerning supposed Human Bones, falsely attributed to King Teutobochus, discovered.' In this pamphlet the bones are denied to be human, and supposed to have been engendered by some virtue in the earth. Another pamphlet was published without a name, in which it is said, that among these bones some were human and others not.

In 1618 Riolan published his Gigantologie, in which he maintains that the bones in question were not only not human, but that men in general were never larger than they are at present.

In the same year Habicot replied to Riolan; he says, that he presented his Gigantosteologie to Louis XIII.; that about the end of July in the year 1613 the bones mentioned in this work were exposed to the eye of the public; and that they are real human bones. He quotes a number of examples from ancient and modern authors, to prove that men of immense stature have existed. He persists in maintaining, that the calcaneum, tibia, and femur of the giant Teutobochus, when joined to each other, were more than 11 feet in length.

He next gives letters written to him at the time these bones were discovered, and which seem to confirm the reality both of the tomb and of the bones of the giant Teutobochus. From a letter written by Seignior de Langon, dated St. Marcellin, in Dauphiny, and another by the Sieur Masurier, a surgeon at Beaurepaire, it appears, that silver coins were found along with the bones. The first letter contains the following passage: ‘As his Majesty,’ says Seignior de Langon, ‘is desirous of having the remaining bones of King Teutobochus, and the silver coins found in the tomb, I declare that your adversaries are ill informed, and that if they knew the matter more perfectly, they would not entertain any doubts, that these bones really belong to the human species. The physicians of Montpellier came here, and would have given any money to purchase the bones. M. le Maréchal de Lesdiguieres made them be carried to Grenoble; and the physicians and surgeons of that place recognised them to be human bones. This fact of course can only be denied by persons who are ignorant of the real circumstances.’

In this dispute neither Riolan nor Habicot, the one a physician and the other a surgeon, have had sense enough to give an exact description of the bones in question. Both of them, actuated by party spirit, have written in a style which destroys all confidence in their assertions. Hence it is extremely difficult to ascertain the species to which these bones really belonged. But if they were found in a brick tomb, with a stone cover, upon which the words *Teutobochus Rex* were inscribed; if coins were found in this tomb; if it contained but a single skeleton of 24 or 25 feet in length; and if Seignior Langon's letter relates nothing but truth, the general fact, *i. e.* the existence of a giant of 24 feet high, unless we should suppose a very extraordinary concourse of falsehood, could not admit of a doubt. But the fact is by no means proved in a manner so explicit as not to leave room for much hesitation. It is true, that several authors, otherwise worthy of credit, have mentioned giants as large, and even larger. Pliny relates, that by an earthquake in Crete a mountain was split, and discovered a human body of 16 cubits long, which some ascribed to that of Otus, and others to that of Orion. Sixteen cubits are equal to 24 feet, which is the same length with the skeleton of King Teutobochus.

In a memoir of M. le Cat, an academician of Rouen, we have an enumeration of several giants of enormous magnitude, namely, two whose skeletons were found near Athens, of which one was 36 and the other 34 feet high; another of 30 feet was found in Sicily near Palermo, in the year 1548; another of 33 feet was likewise found in Sicily in the year 1550; and another was also found in Sicily, near Mazarino, which was thirty feet long.

These testimonies notwithstanding, it is difficult to believe that men of 30 or 36 feet high ever existed: it is perhaps too much to believe in the existence of giants of 24 feet high. However, evidences multiply, become more positive, and gradually increase, in proportion as the dimensions decrease. M. le Cat relates, that in the year 1705, there was found, near the banks of the river Morderi, at the foot of Mount Crussol, the skeleton of a giant which measured 22¼ feet; and that the Dominicans of Valencia have part of the tibia with the joint of the knee.

Platerus, a celebrated physician asserts, that he saw at Lucerne the skeleton of a man which was 19 feet in length.

The giant Ferragus, slain by Rolland, nephew to Charlemagne, was 18 feet high.

In the sepulchral caverns of the island of Teneriff a skeleton was found which measured 15 feet, and in whose jaws were 80 teeth. These three facts, as well as the preceding, are related in M. le Cat's essay concerning giants. He mentions another skeleton found in a ditch near the convent of the Dominicans at Rouen, the skull of which held a bushel of corn, and the bone of the leg was 4 feet long; the whole body of course must have been from 17 to 18 feet in length. Upon the tomb of this giant the following inscription was engraved: ‘Here lies the noble and puissant Seigniur le Chevalier Ricon de Valmont, together with his bones.’

In the Journal Litteraire of the Abbé Nazari, we are told, that in High Calabria, in the month of July 1665, there was dug out of the gardens of Signior de Tiviolo a skeleton of 18 Roman feet long; that the head was 2½ feet; that each grinder weighed about an ounce and a third, and the other teeth three quarters of an ounce; and that this skeleton was bedded in a mass of bitumen.

Hector Boethius, in his history of Scotland, relates, that the bones of a man, ironically called Little John, are still preserved, who was supposed to have been 14 feet high.

In the Journal des Savans, anno 1692, there is a letter from P. Gentil, professor of philosophy at Angers, in which he says, that having been informed of a gigantic body discovered nine leagues from the town of Lassé, he went to the spot to satisfy himself concerning the truth of the fact. He learned from the curate of the place, that in digging his garden a sepulchre was discovered which contained a body of 17 feet 2 inches long. There was no skin on the body. This body had others between its arms and legs, which might have been the person's children. In the same place there were discovered fourteen or fifteen other sepulchres, some of them 10 feet, others 12, and others 14 feet long, which contained bodies of the same dimensions. The sepulchre of this giant continued exposed to the air more than a year; but, as it attracted too many visitors to the Curate, he again covered it with earth, and planted three trees in the place. These sepulchres were constructed with a stone which resembled chalk.

Thomas Molineux saw, in a cabinet at Leyden, a prodigious human frontal bone. From its junction with the nose to the sagittal suture, it was $9\frac{1}{12}$ inches; its length was $12\frac{2}{10}$ inches, and its thickness half an inch, *i. e.* in every dimension it was double that of an ordinary frontal bone. Hence the person to whom this gigantic bone belonged must have been twice the common size of a man, or at least 11 feet high. This bone was unquestionably human; and it seemed not to have acquired this uncommon magnitude by the effects of any disease; for its thickness was exactly proportioned to its other dimensions, which never happens in diseased bones.

M. Klein tells us, that he saw, in the cabinet of M. Witreu at Amsterdam, a frontal bone, from the dimensions of which it appeared, that the person to whom it appertained must have been 13 feet 4 inches high, *i. e.* about $12\frac{1}{2}$ French feet.

After all these facts, I shall leave my readers in the same embarrassment as myself, with regard to the real existence of giants of 24 feet in length. I cannot persuade myself, that at any time, or by any circumstances whatever, the human body could be elevated to such immoderate dimensions. But, at the same time, it is unquestionable, that giants of 10, 12, and perhaps even of 15 feet high, have existed; and it is almost certain, that, in the primæval ages of Nature, not only gigantic individuals, but even permanent and successive races of giants, were produced, of which that of the Patagonians is the only remaining example.

To prove that some of the fishes and plants found in coal and slate belong to species which no longer exist, the Count de Buffon produces the following facts and observations.

With regard to this subject, we shall remark, with M. Lehman, that there are no impressions of plants in slate, except when it accompanies pit-coal; and that, on the contrary, impressions of fishes are seldom found but in coppery slates.

It has likewise been remarked, that, in the district of Mansfield, the beds of slate which contain petrified fishes, are covered with a stratum of stones called *stinking stones.* This stratum is a species of gray slate, which has derived its origin from stagnant water, where the fishes had corrupted before they were petrified.

M. Hoffman, when treating of slates, says, that the petrified fishes found in these stones have not only been living creatures, but that the strata of slate have originated from muddy water, which, after fermenting and petrifying, subsided in thin laminæ or beds.

'In the slate of Angers,' says M. Gucttard, 'there are sometimes impressions of plants and fishes, which merit the greater attention, because the impressions of the plants represent marine *fuci,* or sea wreck, and those of the fishes represent different species of the crustaceous tribes, the impressions of which are more rare than those of scaly fishes, or shells. He adds, that, after consulting several authors who treat of fishes and crustaceous animals, he could not discover any of them that resembled the impressions in question, except the sea-louse, which has some resemblance to them; but it has thirteen rings, and the impressions on the slates have only seven or eight: the impressions of these fishes are generally interspersed with a whitish pyritous substance. It is remarkable, that, in the slates of Angers, as well as in those of other countries, the impressions of fishes are frequent, and those of shells are exceedingly rare, whilst the latter are very common in lime-stone.'

Many proofs might be given that all pit-coal is composed of the spoils of vegetables, mixed with bitumen and sulphur, or rather with the vitriolic, acid, which is perceived when the coal is burning. We often find a great quantity of vegetables in the upper strata of coal; and, in proportion as we descend, we see traces of the decomposition of the same vegetables. There are species of coal which are not fossil wood: that found at Sainte-Agnés, near Lons-le-Saunier, has a perfect resemblance to logs or trunks of fir, in which we distinctly perceive the marks of each year's growth, as well as the pith. These trunks differ only from common fir by being somewhat oval, and by their rings being concentric ellipses. They exceed not a foot in circumference, and their bark is very thick and full of furrows, like that of old firs. But the bark of common firs, of the same size, is always smooth.

'I found,' M. de Gensanne remarks, 'several veins of this kind of coal in the diocese of Montpellier: here the trunks are very large; their texture resembles that of chesnut trees from three to four feet in circumference. These fossils, when burning, have only a slight odour of asphaltis. Their flame and embers resemble those of wood. They are found near the surface of the earth, and commonly indicate the existence of real pit-coal at greater depths.'

These ligneous coals ought to be regarded as wood deposited in a bituminous earth, from which they derive their fossil quality. They are found only in earths of this kind, and always near the surface. They sometimes form the stratum immediately above the seams of real coal. Some of them, which have been impregnated with a small quantity only of bitumen, preserve the shades and colour of wood. 'I found this species,' says M. de Gensanne, 'at Cazarets, near Saint-Jean-de-'Culcul, four leagues from Montpellier. But, when 'broken, this fossil commonly presents a smooth sur-'face, perfectly similar to that of jet. In the same 'canton, near Aseras, there is fossil wood changed into 'a white ferruginous pyrites. The mineral matter 'occupies the heart of the wood; and we distinctly 'perceive the woody substance furrowed and partly 'dissolved by the mineral acid.'

After such proofs, related by M. de Gensanne himself, who is otherwise a good mineralogist, I acknowledge, that I was surprised to see him ascribe the origin of coal to clay more or less impregnated with bitumen. This notion is not only refuted by his own facts, but we shall be convinced by those I am about to relate, that we ought to attribute the origin of every species of coal to the spoils of vegetables mixed with bitumen.

I agree with M. de Gensanne, that neither this fossil wood, nor turf, can be considered as coal completely formed. That found near Lons-le-Saunier has been recently examined by the President de Ruffey, a learned academician of Dijon: he remarks, that this fossil wood makes a near approach to the nature of pit-coal; and that it is found within two or three feet of the surface through an extent of two leagues; that it is from three to four feet thick; that we easily distinguish the species of wood to be oaks, horn-beams, and trembling poplars; that this wood is sometimes in the form of bundles or faggots; that the bark of the logs is well preserved; that the annual circles, the cuts made by the axes, and, at different distances, collections of chips, are plainly distinguishable; that this wood converted into coal is excellent for soldering iron; that, when burning, it diffuses a fetid odour; and that alum has been extracted from it.

'Near the village called *Beichlitz*, about a league from 'the town of Halle, two strata, composed of bituminous 'earth and fossil wood, (of which there are several 'mines in the country of Hesse,) were discovered. It 'is similar to that found in the village of Sainte-Agnés 'in Franche-comté, two leagues from Lons-le-Saunier. 'This mine is in the territory of Saxe. The first stra-'tum lies at the depth of three fathoms and a half, and 'is from eight to nine feet thick. To arrive at it, we 'cut through a white sand, then a whitish gray clay, 'which is three feet thick: still deeper, we meet with a 'considerable thickness both of sand and clay, which 'cover the second stratum. This stratum is only from 'three and a half to four feet thick. We sounded 'deeper, but found no other strata of that kind.

'These strata are horizontal; but they sink or rise 'nearly in the same manner as common strata. They 'consist of a brown bituminous earth, which is friable 'when dry, and resembles corrupted wood. Pieces of 'wood of all sizes are found, which, when taken from 'the mine, where they are soft, must be cut with an ax. 'This wood, when dry, breaks easily. When broke, it 'shines like bitumen; but we distinctly perceive in it 'the whole organization of wood. It is less abundant 'than the bituminous earth, and the workmen lay it 'aside for their own use.

'A bushel, or two quintals, of bituminous earth sells 'for eighteen or twenty French sous. In these strata 'there are pyrites; they are of a vitriolic nature; when 'exposed to the air they effloresce and turn white: but 'the bituminous matter is of little value, as it gives but 'a feeble heat.'

Hence this species of fossil wood, found so near the surface of the earth, must be a much more recent production than common pit-coal, which is almost constantly sunk very deep. But this idea does not preclude the ancient coal from being formed of the spoils of vegetables; since, in the deepest coal-mines, we recognise woody substances, and several characters which belong to vegetables only. Besides, there are some examples of fossil wood found in large masses, and in extensive beds, under strata of free stone and calcareous rocks. Hence there is no other difference between real pit-coal and these charred woods, but what arises from the degree of decomposition, and from a greater or smaller impregnation with bitumen. The basis of their substance is the same, and both derive their origin from the spoils of vegetables.

M. le Monnier, one of the King's physicians, and a learned botanist, found in the schist, or false slate, which traverses a large field of pit-coal in Auvergne, the impressions of several ferns, almost the whole of which were unknown to him: he only thought that he could distinguish the impression of the leaves of the osmund-royal, of which he saw but one example in all Auvergne.

It were to be wished that botanists would examine more accurately the impressions of plants found in pit-coal and in slate. The impressions of plants, as well as those of crustaceous animals, shells, and fishes, found in these minerals, should be drawn and engraved; for all this labour is necessary to enable us to determine the actual or the past existence of these species, or even their relative antiquity. At present, we are satisfied, that most of them are unknown, and that, in those which have been referred to known species, the differences are always so great as to create hesitation.

The Count de Buffon remarks, that the motion of the waters from east to west has diminished the surface of the earth on the west side; and that in every continent of the globe the declivity is more rapid on the west than on the east coasts. This is evident in the continent of America, the declivities of which are extremely rapid and abrupt toward the western seas; but towards the eastern coasts the lands stretch by a gentle declivity, and generally terminate in large plains. In Europe the line that forms the summit of Great Britain, which runs from north to south, is much nearer the western or eastern ocean: for the same reason the seas to the west of Britain and Ireland are much deeper than the sea which separates Britain and Holland. The ridge of Norway is much nearer the ocean than the Baltic sea. The mountains which form the general summit of Europe are much higher toward the west than the east; and if we take a part of this summit, from Switzerland to Siberia, it is much nearer the Baltic and White Seas than the Black Sea and the Caspian. The Alps and Apennines are nearer the Mediterranean than the Adriatic sea. The chain of mountains which runs from Tirol to Dalmatia, and as far as the Morea, in a manner skirts the Adriatic sea; but the opposite coasts are much lower. In Asia, if we follow the chain which extends from the Dardanelles to the strait of Babelmandel, we shall find that the summits of Mount Taurus, of Libanus, and of all Arabia, skirt the Mediterranean and Red Seas; and that to the east there are vast territories where the long coursed rivers run, and at last empty themselves in the Persic Gulf. The summit of the famous mountains of Gate approaches nearer to the western than the eastern seas. The ridge which extends from the west frontiers of China to the point of Mallacca is nearer the west than the east sea. In Africa the chain of Mount Atlas sends rivers to the sea of the Canaries, whose courses are much shorter than those which run into the interior parts of the Continent, and after traversing vast tracts of country lose themselves in lakes or great marshes. The high mountains to the west of Cape Verd, and through all Guinea, after turning round Congo, join the mountains of the Moon, and stretch as far as the Cape of Good Hope, occupy pretty uniformly the middle of Africa: we will perceive, however, on examining the sea to the east and west, that the sea on the east is not deep, and is interspersed with a great number of islands; whilst to the west it is deeper, and has but few islands; so that the deepest places of the western sea are much nearer this chain of mountains than the deepest places of the eastern or Indian seas.

Hence we see, that in general all the points of partition in the great continents are always nearer the west than the east seas; that the plains of these continents are always lengthened toward the east, and shortened toward the west; that the seas on the west coasts are deeper, and have fewer islands than those on the east; and that in all these seas the west coasts of the islands are always higher, and the seas which wash them deeper, than those on the east.

We are next told, that there are animals, and even men, so brutish, that they rather languish in the ungrateful soil where they were brought forth than take the trouble of removing to a more comfortable situation. Of this, says the Count de Buffon, I can give a striking example: the Maillés, a small savage nation in Guiana, near the mouth of the river Ouassa, have no other habitation than trees, upon which they dwell during the whole year, because their country is always more or less covered with water. They never descend from these trees except when they go in canoes in quest of subsistence. This is a singular example of a stupid attachment to a native country; for these savages, in order to procure habitations on land, have only to remove a few leagues from those drowned savannahs which gave them birth, and which they obstinately refuse to abandon. This fact is mentioned by some voyagers, and has been confirmed to me by several witnesses who have lately seen this small nation, which consists of three or four hundred savages. They keep themselves above the water by means of the trees. There they remain the whole year. During the eight or nine rainy months their country is a large sheet of water; and during the four summer months their soil consists of a dirty mud, upon which a crust of five or six inches thick is formed. This crust is rather composed of herbage than of earth, under which is a considerable depth of stagnant and stinking water.

The Caspian Sea, the Count de Buffon remarks, was formerly much larger than it is at present. ‘In traversing,’ says M. Pallas, ‘the immense deserts which lie ‘between the Wolga, the Jaik, the Caspian Sea, and the ‘Don, I observed, that these *steppes* or sandy deserts are ‘every way surrounded with an elevated border, which ‘embraces a great part of the beds of the Jaik, Wolga, ‘and Don; and that these deep rivers, before they penetrated this inclosing belt, were full of islands and ‘shoals, till they began to fall into the deserts where ‘the great river Kuman loses itself in the sands. From ‘these observations I conclude, that the Caspian Sea ‘has formerly covered all these deserts; that it anciently had no other margins than those elevated belts ‘which every where surround the deserts; and that it ‘has communicated, by means of the Don, with the ‘Black Sea, even supposing this sea, as well as that of ‘Azoff, had never made a part of it.’

M. Pallas is unquestionably one of our most learned naturalists; and it is with the greatest pleasure that I see him here entirely of my opinion with regard to the ancient extent of the Caspian, and the probability that it formerly communicated with the Black Sea.

There have been greater and more frequent revolutions in the Indian ocean than in any other part of the globe. But, says the Count de Buffon, tradition has only handed down to us the submersion of Taprobana. The most ancient tradition we have of the sinking of countries in the south is that of the loss of Taprobana, of which the Maldivas and Laquedivas are supposed to have been formerly a part. These islands, as well as the rocks and banks which prevail from Madagascar to the point of India, seem to indicate the summits of countries that united Africa to Asia; for almost all of these islands have on the north side lands and banks which stretch very far under the waters.

It likewise appears, that the islands of Madagascar and Ceylon were formerly united to the adjacent continents. Most of these separations and revolutions in the southern seas have been produced by the sinking of caverns, by earthquakes, and by explosions of subterraneous fires. But lands have also been carried off by the slow and gradual movement of the waters from east to west. The places where these effects are most apparent are the regions of Japan, of China, and of all the eastern parts of Asia. The seas situated to the west of China and Japan seem to be accidental productions, and perhaps more recent than our Mediterranean.

The islands of Sunda, the Moluccas, and the Philippines, present nothing but countries which have been overturned; and they are still full of volcanoes. There are many volcanoes in the Japanese islands; and Japan is reputed to be more subject to earthquakes than any other part of the globe: it also gives rise to a number of hot fountains. The greater part of the islands in the Indian ocean present only peaks or summits of detached mountains, which continually vomit fire. The isles of France and Bourbon appear to be two of these summits: they are almost entirely covered with matters rejected by volcanoes. These two islands, when first discovered, were uninhabited.

In Guiana, our author remarks, the rivers are so near each other, and at the same time so swelled and rapid during the rainy season, that they carry down immense quantities of mud, and deposit them on all the low grounds and on the bottom of the sea. The coasts of French Guiana are so low that they may rather be regarded as beaches totally covered with mud, and having an almost imperceptible declivity. This mud extends to a great distance at the bottom of the sea. Large vessels cannot approach the river Cayenne without striking; and ships of war are obliged to remain two or three leagues from the land. This mud extends along the whole margin of the sea from Cayenne to the river of the Amazons. In this great extent of mud there is no sand, and berry-bearing alders are frequent all along the coast. But seven or eight leagues above Cayenne, westward as far as the river Marony, we find some creeks, the bottoms of which consist of sand and rocks, which give rise to breakers. The mud, however, covers the greater part of these rocks, as well as the beds of sand; and it is thicker in proportion as it recedes from the margin of the sea. These small rocks prevent not the ground from having a very gentle descent for several leagues on land. This part of Guiana, which lies to the north-west of Cayenne, is more elevated than the lands on the south-east. Of this fact we have good evidence; for along the borders of the sea we find large drowned savannahs, most of which are dry in the north-west, whilst they are totally covered with sea-water in the south-east parts. Beside these lands actually drowned by the sea there are others more distant, which have likewise been formerly drowned. In some places we also find savannahs of fresh water; but they produce no alders, but many palm-trees. On all these low coasts not a stone is to be seen. The tide rises seven or eight feet, though it is opposed by the currents; for they are all directed toward the Antilles. When the waters of the rivers are low the tide is very perceptible, as high up the rivers as forty and even fifty leagues. But during the rainy season, when the rivers are swelled, the tide is scarcely perceptible at the distance of a league or two, so great is the rapidity of the waters; and their impetuosity is greatest during the reflux.

Upon the sandy bottoms of these creeks, the sea turtles deposit their eggs; and they never frequent the muddy places; so that from Cayenne to the river of the Amazons there are no turtles; and the people go to fish them from the river Courou to the Marony. The mud appears to gain ground daily on the sand; and in the progress of time the north-west coast of Cayenne will be covered with it as well as the south-east; for the turtles, who will deposit their eggs in sand only, gradually retire from the river Courou; and for some years past the fishers are obliged to search for them near the river Marony, the sands of which are not yet covered.

Beyond the savannahs, some of which are dry and others drowned, there is a chain of hills that are all covered with a great depth of earth, and every where planted with forests. These hills are generally from 350 to 400 feet high. But about ten or twelve leagues farther up the country they are perhaps double this height. Most of these mountains are evidently extinguished volcanoes. At the top of one of them, called la Gabrielle, there is a small lake, in which are a number of alligators, whose species seems to have been preserved from the time that the sea covered this hill.

Beyond Mount Gabrielle, we find only small valleys, little hills, and volcanic matters, not in large masses, but in small blocks. The most common stone, blocks of which are carried down by the waters as far as Cayenne, is that called *beetle-stone*. It is not a stone, but the lava of a volcano. It has received the name of *beetle-stone*, because it is full of holes, which these insects inhabit.

Of the Glaciers.

In the highest regions of the Alps, the waters which proceed from the annual meltings of the snow, freeze in every direction, and on all the points of the mountains from their bases to their summits, and especially in the valleys, and on the declivities of those that are collected together in groups: in this manner, the waters have formed in these valleys some mountains which have rocks for their nucleus, and others that consist entirely of ice: these mountains are six, seven, and even eight leagues long by one in breadth, and often from a thousand, to twelve hundred fathoms high. These enormous masses of ice are continually extending farther along the valleys; for though, in warm and rainy seasons, their progress is not only stopped, but their size diminished, the magnitude of the glaciers is perpetually augmenting.

Under the equator, the point of congelation, in detached mountains, is fixed at the height of 2440 fathoms. But this is no rule for groups of mountains which are frozen from their summits to their base, and never thaw. In the Alps, the point of congelation in detached mountains is ascertained to be at the height of 1500 fathoms, and all below this point thaws completely. But those which are grouped together freeze at a smaller height, and thaw from their top to their base; which shows how much the degree of cold is augmented by immense masses of congealed matter confined within a narrow compass.

The whole frozen mountains of Switzerland, when taken together, occupy an extent of 66 leagues from east to west, measured in a straight line from the western borders of the canton of Vallis towards Savoy, to the eastern borders of the canton of Bendner towards Tirol. They form an interrupted chain, several arms of which extend, from north to south, about 36 leagues. The great Gothard, the Fourk, and the Grimsel, are the highest mountains in this quarter: they occupy the center of those chains which divide Switzerland into two parts. They are perpetually covered with snow and ice; from which circumstance they have received the general denomination of *Glaciers*.

The glaciers are divided into frozen mountains, valleys of ice, fields of ice or frozen seas, and *gletchers*, or heaps of icy flakes or plates.

The frozen mountains are those immense masses of rocks which reach the clouds, and are perpetually covered with ice and snow.

The valleys of ice are those depressions between the mountains which are much more elevated than the inhabited valleys. They are always filled with snow, which accumulates, and forms masses of ice several leagues in length. These masses join the high mountains.

The fields of ice, or frozen seas, which lie along the mountains, have a gentle declivity. They cannot be called valleys, because they are not sufficiently depressed. They are covered with a great thickness of snow. These fields receive water from the melting of the snow, which descends from the mountains, and afterwards freezes. The surface of these fields alternately melts and freezes; and the whole are covered with thick beds of snow and ice.

The gletchers are heaps of flakes or plates of ice formed by the snows, and precipitated from the mountains. These snows freeze again, and are interwoven in various manners: this circumstance has given rise to the division of gletchers into mounts, mantlings, and walls of ice.

The mounts of ice rise between the summits of the high mountains: they themselves form mountains; but they contain no rocks. They are composed entirely of ice, and are sometimes several leagues in length, one league broad, and half a league thick.

The mantlings are formed in the superior valleys, and upon the sides of the mountains, which are covered with ice, having folds resembling drapery: they send their superfluous waters into the lower valleys.

The walls of ice are rugged mantlings which terminate the flat valleys, and appear, at a distance, like troubled seas, whose waves have been suddenly arrested and frozen. These walls consist not of irregular points: they often form columns, pyramids, and enormous towers composed of several sides. These towers are sometimes hexagonal, and of a blue or greenish colour.

On the sides, and at the foot of the mountains, masses of snow are formed, which are afterwards moistened with the water from the melted snows, and then covered with fresh accumulations. We likewise see plates of ice collected in heaps, which belong neither to the frozen valleys nor the mountains of ice. Their position is either horizontal or inclined. These detached heaps are called *beds* or *strata* of ice.

Several of these mountains of ice are undermined by the interior heat of the earth, which gives rise to currents of water that melts their inferior surfaces. They then, by their own weight, sink insensibly, and their height is restored by the waters, snow, and ice, which again successively cover them. These sinkings often produce horrible crashings. The crevices which open in the ice form precipices which are both numerous and full of danger. These abysses are the more treacherous and baneful, because they are generally covered with snow. Travellers, and hunters who chase the fallow-deer, the chamois goat, &c. or those who search for crystals, are often swallowed up by these gulfs, and again thrown upon the surface by the waters which run at their bottoms.

Gentle rain quickly dissolves snows: but all the water which proceeds from them falls not into these gulfs. A great part of it freezes on the surface of the ice and augments its volume.

The warm south winds, which generally prevail in the month of May, are the most powerful agents in destroying the snows and ice. Their melting is announced by the crashing of the frozen lakes, and the dreadful noise produced by the shock of stones and ice, which in horrible confusion roll down from the tops of the mountains, and by torrents of water that fall from the rocks of more than 1200 feet high.

The heat of the sun has little effect upon the snow and ice. Experience has proved, that ice which has existed a long time under an enormous weight, and in accumulated degrees of cold, is so dense and so completely deprived of air, that, when small pieces of it are exposed to the greatest heat of the sun, during a whole day, they scarcely melt.

Though the glaciers melt partially every summer, though the winds and the heat of certain years destroy the accumulation of several preceding years; yet it is certain, that these *glaciers constantly augment in all their dimensions*. This fact is ascertained by the annals of the country, by authentic deeds, and by invariable tradition. Independent of these authorities, and of daily observation, the progressive increase of the glaciers is proved by *forests of trees which have been absorbed by the ice, some of whose tops still appear above the surface of the glaciers*: these, as well as *the tops of steeples belonging to a village* that had been buried under the snows, and which are still visible after uncommon meltings, are irrefragable evidences of the gradual progress of the glaciers. This progression can proceed from no other cause than an augmentation in the degree of cold, which increases in proportion to the masses of accumulated ice. It is likewise certain, that, in the glaciers of Switzerland, the cold is at present more intense, though it continues shorter, than in Iceland, the glaciers of which, as well as those of Norway, have a great relation to those of Switzerland.

The substance of the frozen mountains of Switzerland is similar to that of all other high mountains. The nucleus is a vitreous rock which reaches to their summit. The parts below, which had been covered with the ocean. are composed of calcareous stone, as well as the whole substance of the mountains of an inferior order, which are disposed in groups at the foot of the primitive glacier mountains. Lastly, these calcareous masses have slate, produced by the sediments of the waters, for their basis.

The vitreous masses are pure rock, granite, and quartz. Their fissures are filled with metals, semi-metals, mineral substances, and crystals.

The calcareous masses are lime-stone, marbles of every species, chalk, gypsum, spar, alabaster, &c.

The slaty masses consist of slates of various qualities and colours, which contain plants and fishes, and are often situated at considerable heights. Their strata are not always horizontal. They are often inclined, sometimes sinuated, and in particular places perpendicular.

We cannot entertain a doubt concerning the ancient abode of the sea upon the glacier mountains. The immense quantity of shells, as well as the slate and other similar stones, found in these mountains, fully ascertain this point. These shells are either distributed in tribes, or different species are blended together, and they are found at very great heights.

It is probable, that, at a very remote period, the glaciers had not been formed on these mountains, not even when the ocean abandoned them; though it appears by their great distance from the sea, which is near a hundred leagues, and by their excessive height, that they were the first that arose above the water in the Continent of Europe. They have likewise had their volcanoes. Mount Myssenberg, in the canton of Schwitz, seems to have been the last volcano that was extinguished. The two principal summits, which are very high and detached, terminate in cones, like all the mouths of volcanoes; and we still see the crater of one of these cones, which is very deep.

M. Bourrit, who had the courage to make a number of expeditions in the glaciers of Savoy, remarks, 'That 'the increase of all the glaciers in the Alps is unquestionable; that the quantity of snow that falls during 'the winters far surpasses that which melts in the summers; that the same cause not only subsists, but the 'masses of snow already formed must always augment, 'because this effect is a necessary result of that cause. 'Hence the glaciers must always continue to have a 'progressive increase.'

The same indefatigable observer, when treating of the *glatchers* or glaciers with prominent points, says, 'that 'they appear to augment daily; that the ground they 'now occupy was some years ago a cultivated field; and 'that the ice still continues to augment.' He relates, 'that the growth of the ice is evident, not only in this 'place, but in several others; that the inhabitants remembered a former communication between Chamounis and Val-d'Aost, which is now totally shut up by 'the ice; that the ice, in general, must have first accumulated by stretching from summit to summit, and 'then from one valley to another; and that, in this 'manner a communication has been formed between the 'ice of Mount Blanc and those of the other mountains 'of Vallais and of Switzerland. It appears,' says he, 'that all these mountainous countries were not anciently 'so much filled with ice and snow as they are at present.

'It is only a few centuries since various calamities have 'been occasioned by the accumulation of snows and ice 'in several valleys, and by the precipitation of mountains and rocks. It is only from these accidents, which 'are very frequent, and from the annual accumulations 'of the ice, that we are enabled to account for what history relates concerning the ancient inhabitants of this 'country.'

Of the North-East Passage.

Notwithstanding what has been advanced by the Russians it is extremely doubtful that they ever doubled the northern part of Asia. M. Engel, who regards the north-west passage by Hudson's and Baffin's bay as impossible, appears on the contrary to be persuaded, that a shorter and more certain passage will be found by the north-east. To the feeble reasons he gives in support of this opinion, he adds a remark of M. Gmelin, who when speaking of the experiments made by the Russians in order to discover this north-east passage says, 'that the manner in which they proceeded in making these discoveries will astonish the whole world, 'after an authentic relation of them shall be made 'public, which depends solely on the pleasure of the 'empress.'—'There can be nothing astonishing,' says M. Engel, 'in this subject, except it be to learn that a 'passage, which was formerly regarded as impossible, is 'now found to be extremely practicable. This is the 'only fact,' he adds, 'which can surprise those whom 'the Russians have endeavoured to terrify by relations 'published for the purpose of repelling navigators from 'the attempt,' &c.

I shall in the first place remark, that we ought to be well ascertained with regard to facts, before we throw an imputation of this kind upon the Russian empire. In the second place the remark seems to be ill-founded; for the words employed by M. Gmelin may admit of an opposite interpretation from that given of them by M. Engel, namely, that we will be astonished when we shall learn that no practicable passage exists by the north-east. Independent of the general reasons I have given, I am confirmed in this opinion by the following circumstance: the Russians themselves in their late experiments uniformly ascend by Kamtschatka, and never descend by the point of Asia. Captains Bering and Tschirikow, in the year 1741, reconnoitred the coast of America as far as the 59th degree; but neither of them sailed northward along the coasts of Asia. This fact is a sufficient proof that the passage is not so practicable as M. Engel supposes; or rather, that the Russians are satisfied that it is not practicable; for if otherwise their navigators would have been sent by this route, instead of making them take their departure from Kamtschatka, in order to discover the west of America.

M. Muller, who was sent by the empress, along with M. Gmelin, to Siberia, is of a very different opinion from M. Engel. After comparing all the relations on this subject, M. Muller concludes by remarking, that there is only a very small separation between Asia and America; and that this strait contains several islands, which serve as common stations to the inhabitants of both continents. This opinion, I believe, is well founded; and in support of it M. Muller has collected a great number of facts. In the subterraneous abodes of the inhabitants of the island of Karaga we see beams made of large pines, which neither this island nor the adjacent countries of Kamtschatka produce. The inhabitants say, that this wood is driven upon their coasts by the east wind. On the coasts of Kamtschatka boards of ice are driven for several days together during the winter. At certain seasons flights of birds arrive, and after staying some months return to the east, from whence they came. Hence the continent opposite to that of Asia, toward the north, descends as far as Kamtschatka. This continent must be the west of America. M. Muller, after giving an abridgment of five or six voyages attempted by the north sea, with a view to double the north point of Asia, concludes, that every circumstance announces the impossibility of this navigation, which he proves by the following arguments. This navigation must be performed in summer: the distance from Archangel to the Oby, and from this river to Jenisey, requires a whole season. The passage by Waygait has cost infinite labour to the British and Dutch. In going through this icy strait we meet with islands which block up the road; and the continent, which forms a cape between the rivers Piasida and Chatanga, and advances beyond the 76th degree of latitude, is likewise bordered with a chain of islands, which scarcely leave a passage for navigation. If we want to remove from the coasts, and to reach the open sea toward the Pole, the almost immoveable mountains of ice, found at Greenland and Spitzbergen, seem to indicate a continuity of ice as far as the Pole. If we want to go along the coasts, *this navigation is more difficult now than it was a hundred years ago.* There the waters of the ocean are sensibly diminished: we still see, at a distance from the shoals along the Frozen Sea, wood that had been thrown upon the lands which formerly bounded the ocean. These shoals have so little depth, that very flat boats can alone be used in them; such boats are too weak to resist the ice; neither can they contain provisions sufficient for a long navigation. Though the Russians have resources for sailing these cold seas superior to those of most other European nations, yet in none of the voyages attempted upon the Frozen Sea has a passage been discovered between Europe or Asia to America. It is only by departing from Kamtschatka, or some other more easterly point of Asia, that the westerly coasts of America have ever been discovered.

Captain Bering took his departure from port Awatscha in Kamtschatka on the 4th day of June 1741. After sailing south-east, and then north-east, he discovered on the 18th of July, the continent of America in latitude 58° 28′. Two days after he anchored near an island in the mouth of a bay, from whence he discovered two capes, the one to the east he called Saint-Elie, and the other to the west Saint-Hermogene. He then dispatched Chitrou, one of his officers, to reconnoitre the gulf which he had entered: they found that it was interspersed with islands, on one of which they saw deserted cabins made of planks well joined, and even chamfered. They conjectured that this island might have been inhabited by some people from the continent of America. M. Steller, who was sent to make observations on these new discovered lands, found a cave, in which were a quantity of smoked salmon, ropes, furniture, and other utensils. Advancing still farther he saw the Americans flying from him. He next perceived a fire on a distant hill. The savages had unquestionably retired thither: a rugged and steep rock covered their retreat.

After relating these facts, it is easy to perceive, that it is only by taking their departure from Kamtschatka that the Russians can carry on commerce with China and Japan, and that it is equally difficult, if not impossible, for the other nations of Europe to pass by the north-east seas, the greater part of which are entirely frozen. Hence I cannot hesitate in repeating, that the only possible passage is by the north-west, at the bottom of Hudson's bay, and that this is the place where all future attempts to discover this useful passage ought to be made.

After the preceding sheets had been printed, I received from M. le Comte Schouvaloff, that great statesman whom all Europe esteems and respects, an excellent memoir composed by M. de Domascheneff, president of the Imperial Society of Petersburg, and to whom the empress has assigned the department of every thing relating to arts and sciences. This illustrious person has likewise sent me a copy of the chart drawn by the pilot Otcheredin, in which are represented the tracks and discoveries he made in the years 1770 and 1773, between Kamtschatka and the continent of America. M. de Domascheneff in his memoir remarks, that this chart of the pilot Otcheredin is most exact, and that the one published in the year 1773, by the Academy of Petersburg, requires several amendments, especially with regard to the position of the islands and the pretended Archipelago, which are represented between the Aleutes or Aleoutes islands, and those of Anadir, otherwise called Andrien. The chart of Otcheredin seems to show, that these two groups of islands, the Aleutes and the islands of Andrien, are separated by an open sea of more than a hundred leagues broad. M. de Domascheneff assures us, that the great general chart of the Russian empire, published in the year 1777, gives an accurate representation of all the coasts on the northern extremity of Asia inhabited by the Tschutchis; he says, that this chart was executed from the most recent discoveries made in the last expedition of Major Pawluzki against that people. 'This coast,' says M. de Domascheneff, 'bounds the great chain of mountains which separate 'Siberia from the south of Asia, and terminates by dividing itself between the chain that stretches through 'Kamtschatka, and those which occupy the territories 'between the rivers that run to the east of the Lena. 'The known islands between the coasts of Kamtschatka 'and those of America are mountainous, as well as the 'coasts of Kamtschatka, and those of the continent of 'America. Hence there is a distinct continuation between the chains of mountains belonging to both 'continents, the intervals of which, perhaps less considerable formerly, may have been enlarged by the 'decaying of rocks, by the perpetual currents which run 'from the Frozen Sea toward the southern ocean, and 'by the revolutions which the earth has undergone.'

But this submarine chain which joins the lands of Kamtschatka to those of America is more southerly, by seven or eight degrees, than that of the islands of Anadir or Andrien, which from time immemorial have served the Tschutschis as a passage to America.

According to M. de Domascheneff, it is certain, that this voyage from the point of Asia to the continent of America is performed by oars, and that these people go there to dispose of Russian iron-works to the Americans; that the islands in this passage are so frequent, that the sailors may sleep every night on land; and that the continent of America, with which the Tsheutschis traffick, is mountainous, and covered with forests, which are full of foxes, martins, and sables, the qualities and colours of whose furs are totally different from those of Siberia. These northern islands, situated between the two continents, are known to the Tschutschis only. They form a chain between the most eastern point of Asia and the continent of America, under the 64th degree of latitude; and this chain is divided by an open sea, from the other more southern chain formerly mentioned, which lies between Kamtschatka and America, and is under the 56th degree. The islands of this second chain the Russians and inhabitants of Kamtschatka frequent in quest of sea otters and black foxes, whose furs are very precious. Before the year 1750 even the most eastern of the islands which compose this chain were known. One of these islands bears the name of Captain Bering, and another, adjacent to the former, is called the island of Medenoi. We next meet with the islands of Aleutes or Aleoutes. The two first are situated a little above, and the last a little below the 55th degree of latitude. About the 56th degree we find the islands of Atkhou and Amlaigh, which are the first of the chain called the Islands of Foxes: they extend as far to the north-east as the 61st degree of latitude. These islands have received their denomination from the prodigious number of foxes found in them. The two islands of Captain Bering and Medenoi were uninhabited when first discovered. But, in the islands of Aleutes, though advanced farther to the east, more than sixty families were found, whose language had no relation either to that of Kamtschatka or to any of the oriental languages of Asia: it is a dialogue of the language spoken in the other islands adjacent to America, which seems to indicate that they have been peopled by the Americans, and not by the Asiatics.

The islands called by Captain Bering's crew Saint-Julian, Saint-Theodor, and Saint-Abraham, are the same with those which now receive the name of Aleutes. In the same manner, the islands of Chommaghin and Saint-Dolmat, discovered by this navigator, form a part of those now called the Islands of Foxes.

'The great distance,' says M. de Domascheneff, 'and the open and deep sea between the islands of 'Aleutes and those of Foxes, joined to the different 'direction of the latter, render it probable, that these 'islands never formed one continued chain, but that the 'former, with those of Medenoi and Bering, make a 'chain which comes from Kamtschatka; that the Islands 'of Foxes exhibit another passage to America; and that 'both of these chains generally lose themselves in the 'depth of the ocean, and are promontories to the two 'continents. The course of the Islands of Foxes, some 'of which are of great extent, is intermixed with rocks and 'breakers, and continues without interruption as far as 'the continent of America. But those most adjacent to 'this continent are very little frequented by the Russian 'hunters; because they are very populous, and it would 'be dangerous to sojourn in them. There are several 'islands in the neighbourhood of America which are 'still little known. Some ships, however, have pene'trated as far as the island of Kadjack, which is very 'near the continent of America. We are assured of 'this fact by the relation of the islanders; and other 'circumstances confirm the truth of their assertion: all 'the islands that lie more to the west, produce only 'dwarfish and mis-shapen shrubs, which the winds from 'the open sea prevent from rising higher. The island 'of Kadjack, on the contrary, and the small adjacent 'islands, produce groves of alder-trees, which seem to 'indicate that they are less exposed, and that they are 'sheltered on the north and east by a neighbouring con'tinent. Besides, in Kadjack, we find fresh-water 'otters, which appear not in the other islands; and we 'likewise find a small species of marmot, which seems 'to be the marmot of Canada. Lastly, we discover, in 'that island, traces of the bear and wolf; and the inha'bitants clothe themselves with rain-deer skins brought 'to them from the continent of America, to which they 'lie very contiguous.

'From a voyage to the island of Kadjack, conducted 'by one Geottof, we learn, that the continent of Ame'rica is called *Atakthan* by the islanders: they say, that 'this great land is mountainous and covered with forests; 'that it is situated to the north of their island; and 'that the mouth of a great river there goes by the name 'of *Alaghschak*. Besides, it is unquestionable, that 'Bering, as well as Tschirikow, actually reached this 'great continent; for, at Cape Elie, where Bering 'moored his frigate, they saw the coast rise into a chain 'of mountains which were covered with thick forests. 'The soil was of a nature totally different from that of 'Kamtschatka; and Steller collected a number of Ame'rican plants.'

M. de Domascheneff farther observes, that all the Islands of Foxes, as well as those of Aleutes and Bering, are mountainous; that their coasts are rocky, often terminate in precipices, and are surrounded to a considerable distance with rocks; that the country rises, from the coasts to the middle of these islands, into rugged mountains, which form small chains through the whole length of each island. Besides, there have been, and still are, volcanoes in several of these islands; and in those where the volcanoes are extinguished, there are fountains of hot water. In the islands with the volcanoes, no metals are found, but only calcedons and some other coloured stones of no value. In these islands, the inhabitants have no other wood but what is floated into them by the sea, and the quantity is not great. More wood arrives in the island of Bering and the Aleutes. This floated wood seems to come from the south; for the camphor tree of Japan has been found on the coasts of these islands.

The inhabitants are pretty numerous; but, as they lead a wandering life, and transport themselves from one island to another, it is not possible to ascertain their number. It has been remarked, in general, that the larger the islands are, they are the nearer America, and the more populous. It likewise appears, that all the inhabitants of the Islands of Foxes are of the same nation, to which those of the Aleutes and the islands of Andrien may also be referred, though they differ in some customs. All these people, in their manners, modes of living, and of feeding, have a great resemblance to the Esquimaux and the Greenlanders. *Kanaghist*, the name of these islanders in their own language, and perhaps corrupted by the mariners, has still a great affinity to *Karalit*, the denomination of the Esquimaux and their brethren the Greenlanders. Among the inhabitants of all the islands between Asia and America, no other utensils were found but stone-hatchets, flint-knives, and the shoulder bones of animals sharpened to cut herbage. They have likewise darts armed with sharp flints, and most artfully cut. They have now a great many implements of iron, which they have obtained from the Russians. They make canoes like the Esquimaux; some of them are so large that they contain twenty persons. They are made of light wood, and are entirely covered with the skins of seals and other sea-animals.

From all these facts, it appears, that, from time immemorial, the Tschutschis, who inhabit the eastern point of Asia between the 55th and 70th degree of latitude, have had commerce with the Americans; that this intercourse was the more easy to a people accustomed to all the rigours of cold; and that the voyage, which perhaps exceeds not a hundred leagues, might be performed in simple canoes, conducted by oars in summer, and probably on the ice in winter, by landing daily upon a different island. America, therefore, might he peopled by Asia under this parallel; and every circumstance seems to indicate, that, though there are now intervals of sea between these islands, they formerly constituted but one continent, by which America was joined to Asia. It is likewise probable, that, beyond the islands of Anadir or Andrien, *i. e.* between the 70th and 75th degree of latitude, the two continents are absolutely united, though that track of land is perhaps entirely covered with snow and ice. To explore the regions beyond the 70th degree is an enterprise worthy of the great sovereign of the Russias, and it ought to be entrusted to a navigator equally intrepid as Captain Phipps. I am persuaded, that they would find the two continents united; but, if otherwise, and if there is an open sea beyond the islands of Andrien, it appears to be certain, that they would find the projections of the great Polar glacier at the 81st or 82d degree, as Captain Phipps discovered them at the same latitude between Spitzbergen and Greenland.

Concerning that Period when the Powers of Man aided those of Nature.

The first men were witnesses of the convulsive motions of the earth, which were then frequent and terrible. For a refuge against inundations, they had nothing but the mountains, which they were often forced to abandon by the fire of volcanoes. They trembled on ground which trembled under their feet. Naked in mind as well as in body, exposed to the injuries of every element, victims to the rapacity of ferocious animals, which they were unable to combat, penetrated with the common sentiment of terror, and pressed by necessity, they must have quickly associated, at first to protect themselves by their numbers, and then to afford mutual aid to each other in forming habitations and weapons of defence. They began with sharpening into the figure of axes those hard flints, those *thunder-stones,* which their descendants imagined to have been produced by thunder, and to have fallen from the clouds, but which, in reality, are the first monuments of human art. They would soon extract fire from these flints by striking them against each other.

To destroy the brushwood and the forests, they would employ the flames derived from volcanoes, or from their burning lavas; for, with the assistance of this powerful element, they cleared and purified the grounds which they chose to inhabit. With the axes of stone, they cut trees, and fabricated those weapons and utensils of which necessity first suggested the use; and, after being provided with clubs and other heavy armour, would not these first men discover the means of making lighter weapons to annoy at a distance? The tendon of an animal, the fibres of aloes, or the pliant bark of some ligneous plant, would serve them for a cord to unite the extremities of an elastic branch; with which they made their bow: to arm their arrows, they employed small sharp flints. In a short time they would have thread, rafts, and canoes; and in this state they would remain till little nations were formed. These nations were composed of a few families, or rather of the descendants of the same family, which is still the condition of those savages who live independent in such open and spacious territories as afford them game, fishes, and fruits. But in territories which are narrowed by waters, or confined by high mountains, these small nations, after a great increase of population, were obliged to divide the land among themselves; and, from this moment, the earth became the inheritance of man. He took possession of it by his labour and cultivation; and the attachment to a native soil followed rapidly the first acts of property. As individual interest constitutes a part of national order, government and laws must have succeeded, and society must have assumed strength and consistence.

Nevertheless these men, deeply affected with the miseries of their original state, and having still before their eyes the ravages of inundations, the conflagrations of volcanoes, and gulfs opened by the successions of the earth, have preserved a durable and almost eternal remembrance of the calamities the world has suffered. The idea that it must perish by an universal deluge, or by a general conflagration; the reverence for certain mountains upon which they had been saved from inundations; their horror at others which threw out fires more dreadful than those of thunder; the view of those combats between the earth and heavens, which gave rise to the fable of the Titans, and of their assaults against the Gods; the notion of the real existence of a malevolent being, with the terror and superstition which it unavoidably produced; all these sentiments, founded upon fear, took an unconquerable possession of the human mind. Even at present men are not entirely emancipated from these superstitious terrors by the experience of time, by the tranquillity which succeeded those ages of convulsions and storms, nor by the knowledge of the effects and operations of nature, a knowledge which could not be acquired till after the establishment of some great society in a tranquil land.

It is neither in Africa, nor in the most southern regions of Asia, that great societies or nations could be first formed. These countries were still burning and desert. Neither could this event happen in America, which, except its chain of mountains, is evidently a new country ; nor even in Europe, which very lately derived its learning from the east, where the first civilized men were established ; for before the foundation of Rome the happiest countries in this part of the world, such as Italy, France, and Germany, were then peopled with men more than half savage. Tacitus, in his Manners of the Germans, exhibits a picture of those of the Hurons, or rather of men just emerging from a state of nature. Hence the source of human knowledge must have arisen in the northern countries of Asia ; and power is a necessary result of knowledge. The more man knows the more he can perform ; and the less he has done, the less he knows. All this implies an active people in a happy climate, living under a pure sky and in a fertile country, remote from inundations and volcanoes: it must also have been a high country, and of course more anciently temperate than the more southern regions. Now all these conditions, all these circumstances, are united in the centre of Asia, from the 40th to the 55th degree of latitude. The rivers which run into the North Sea, into the Eastern Ocean, and into the South and Caspian Seas, take their rise from this elevated region, which at present composes the southern part of Siberia and of Tartary. It is therefore in this country, which is more elevated than all the others, since it serves them as a centre, and is near five hundred leagues from any ocean ; it is in this privileged country that the first people worthy of notice were produced ; and they merit our esteem as the inventors of arts, sciences, and every useful institution. This truth is equally evident from the monuments of natural history, and from the almost inconceivable progress of astronomy. How could men so new invent the lunisolar period of six hundred years ? I confine myself to this single fact, though many others equally wonderful and permanent might be produced. These people therefore knew as much of astronomy as was known in the days of Cassini, who first demonstrated the reality and exactness of this period of six hundred years ; a knowledge of which the Chaldeans, Egyptians, and Greeks, were perfectly ignorant ; a knowledge which presupposes that of the exact movements of the earth and moon, and requires great perfection in the instruments necessary to make observations ; a knowledge, which as it implies the acquisition of every thing derived from a long succession of astronomical study and research, must have required at least two or three thousand years exertion of the human mind.

These first people, because they had become very learned, must have been proportionally happy. They must have enjoyed many ages of peace and leisure, which are necessary for the cultivation of science. Before they could entertain a suspicion concerning the period of six hundred years, at least twelve hundred years of astronomical observations were requisite ; and to ascertain the fact, more than double that number of years were necessary. Thus we have already about three thousand years employed in astronomical studies : neither should this circumstance surprise us ; for in reckoning from the Chaldean astronomers to the present day, an equal time has been employed in discovering this period of six hundred years. Besides, these three thousand years of astronomical observations must necessarily have been preceded by many ages in which science was unknown. Nay, are six thousand years from the present time sufficient to discover the most noble epoch in the history of man, or even to trace his gradual progress in the arts and sciences ?

But unhappily these sublime and beautiful sciences are lost : we can only recognise their past existence by deformed and imperfect fragments. The invention of the *formula*, by which the Brahmins calculate eclipses, presupposes as much science as the construction of our ephemerides ; and yet these Brahmins have not the smallest idea of the structure of the universe. They possess only some false notions concerning the motion, magnitude, and position of the planets. They calculate eclipses without knowing the theory of them. This operation they are enabled to perfom by machines or tables founded upon learned formulæ, which they do not comprehend, and which probably were not invented by their ancestors ; because they have never brought any thing to perfection, and have not transmitted the smallest ray of science to their descendants. In their hands these formulæ are only practical methods ; but they imply profound knowledge, of which these people have not preserved the slightest vestige, and which of course they have never possessed. Hence these methods could only proceed from that ancient people, who had reduced into formulæ the motion of the stars, and who, by a long course of observations, could not only predict eclipses, but what is much more difficult, they recognised the period of six hundred years, and of course were acquainted with all those astronomical facts which this discovery necessarily required.

I may affirm that the Brahmins never invented these formulæ ; because all their physical ideas are contrary to the theory on which these formulæ depend. If they had comprehended this theory, even at the time they received its results, the science would have been preserved, and they would not, as they do at present, have entertained the most absurd and ignorant notions concerning the system of the universe ; for they believe that the earth is immoveable, and is supported by a mountain of gold; that the moon is eclipsed by ærial dragons; that the planets are smaller than the moon, &c. It is therefore evident, that they never had the first elements of astronomical theory, nor the smallest knowledge of the principles upon which the methods they employ depend.

The Chinese, who are a little more enlightened than the Brahmins, calculate eclipses in a very rude manner, and they have continued to calculate them in the same manner for two or three thousand years. As they bring nothing to perfection, they can never invent. Hence science neither originated in China nor in India. Though equally near as the Indians to the first learned people, the Chinese appear not to have derived any advantage from this favourable situation. They are not even possessed of those astronomical formulæ of which the Brahmins have preserved the use, and which constitute the first great monuments of the knowledge and happiness of man. Neither does it appear that the Chaldeans, Persians, Egyptians, or Greeks, received any advantage from this first enlightened race of men; for in these Levant countries the new astronomy must be ascribed to the indefatigable assiduity of the Chaldean observers, and afterwards to the labour of the Greeks, which can only be dated from the foundation of the Alexandrian school. This science, however, after the culture of two thousand years, and even till these two or three last centuries, was very imperfect. It seems therefore to be certain, that these people, who first invented, and for a long succession of ages so happily cultivated astronomy, have left nothing but some fragments, some results of the science, which might be retained in the memory, such as that of the period of six hundred years, which has been transmitted to us by Josephus the Jewish historian, who did not understand its value or import.

The loss of the sciences, that first wound to humanity inflicted by the sword of barbarity, must have been the effect of some direful revolution, which in a few years perhaps destroyed the labours and ingenuity of many ages; for those first powerful and learned people must have continued long in a state of splendour and prosperity, since they made so great progress in the sciences, and of course in all the arts which the study of them necessarily require. But it is extremely probable, that when the regions to the north of this happy country had become too cold, their inhabitants, still ignorant, ferocious, and barbarous, would pour in upon this rich and cultivated country. It is even astonishing that these barbarians should have been able to annihilate not only the principles, but the remembrance of all science. Three thousand years of ignorance perhaps followed the three thousand years of light and knowledge which had preceded them. Of all these first and beautiful fruits of the human genius there now remains nothing but a metaphysical religion, which, being incomprehensible, required no study, and could neither be altered nor lost but by a defect of memory, which never fails when it is struck with the marvellous. From this first centre of the sciences the same metaphysical religion diffused itself over every quarter of the globe. The idols of Calicut are the same with those of Seleginskoi. Pilgrimages to the great Lama are undertaken at the distance of more than two thousand leagues. The idea of the metempsycosis, or transmigration of souls, extends still farther, and is adopted as an article of faith by the Indians, the Ethiopians, and the Atlantes. The same notions, a little disguised, were received by the Chinese, Persians, Greeks, and Romans. Every circumstance concurs in proving that the first common stem of human knowledge arose in this region of Asia, and that its barren or degenerated branches extended into every part of the earth.

[The learned M. Pallas remarks, that the cultivation, the arts, and the towns thinly scattered through this region, are living monuments of an empire or flourishing society, whose history is buried with its cities, temples, and arms, of which enormous ruins are daily dug out of the earth. These scattered people are the members of a great nation which has no head.—*Voyage en Siberie.*]

The past ages of barbarity are for ever buried in profound darkness. Men were then so deformed with ignorance that human nature was hardly recognisable: for rudeness, followed by the neglect of duty, began to relax the bonds of society, which were afterwards torn asunder by barbarity; the laws were despised or proscribed; manners degenerated into habits of ferocity; the love of society, though engraven on the human heart, was totally effaced; in a word, man without education, without morals, was reduced to lead a solitary and savage life, and instead of the high dignity of his nature, presented the picture of a being degraded below the brutes.

However, after the loss of the sciences, the useful arts to which they had given birth were preserved. The cultivation of the earth, which became more necessary in proportion to the increase of population; all the arts and practices which this culture requires, as well as all those employed in the construction of buildings, in the fabrication of idols and arms, in the weaving of stuffs, &c. survived the sciences. These arts were gradually diffused and brought to perfection: they followed the course of population. The ancient empire of China first arose, and nearly at the same time that of the Atlantes in Africa. The empires on the continent of Asia, those of Egypt and Ethiopia, were successively established, and lastly, that of Rome, to which our Europe owes its civil existence. Hence, about three thousand years only have elapsed since the power of man united with that of Nature, and spread over the greatest part of the earth.

Before this period, the treasures of fertility were buried. The other resources of man, still more profoundly interred, could not elude his researches, but have become the reward of his labours. When he conducted himself with wisdom, he followed the lessons of Nature; he derived advantage from her examples; he employed her means, and, from the immensity of her productions, selected all those objects from which he could derive either utility or pleasure. By his intelligence the animals were subdued, tamed, and reduced to perpetual slavery. By his labours, the marshes were drained, the rivers were restrained, and their cataracts effaced, the forests were cleared, and the earth cultivated. By his reflection, times were computed, spaces were measured, the celestial motions were recognised, combined, and represented, the heavens and the earth were compared, the universe was augmented, and the Creator worthily adored. By his art, which is an emanation of science, the seas have been traversed, and the mountains overcome; nations have been united; a new world has been discovered; a thousand other detached lands have been reduced under his dominion; lastly, the whole face of the earth at present exhibits the marks of his power, which, though subordinate to that of Nature, often exceeds, at least, so wonderfully seconds her operations, that, by the aid of his hands, her whole extent is unfolded, and she has gradually arrived at that point of perfection and magnificence in which we now behold her.

Compare rude with cultivated Nature. Compare the small savage nations of America with those of our civilised people, or even with those of Africa, who are only half cultivated. Contemplate the condition of the lands which those nations inhabit, and you will easily perceive the insignificance of men who have made so little impression on their native soil. Whether from stupidity or indolence, these brutish men, these unpolished nations, great or small, give no support to the Earth; they starve without fertilizing her; they devour every thing, and propagate nothing. The savage state, however, is not the most despicable condition of mankind, but that of those nations who have just begun to be polished, who have always been the real scourges of human nature, and who, even at present, can hardly be restrained by the people who are completely civilized. They have, as formerly remarked, ravaged the first happy land. They have torn up the germs of happiness, and destroyed the fruits of science. How many invasions have succeeded this first irruption of barbarians? From these same northern regions, where every human virtue formerly existed, all our evils afterwards proceeded. How often have we seen these irruptions of animals with human faces, who always come from the north, ravage the countries of the south? Consult the annals of all nations, and you will find twenty ages of desolation, for a few years of ease and tranquillity.

Nature required six hundred ages to construct her great works, to temper the earth, to fashion its surface, and to arrive at repose: how many ages would men require before they ceased to disturb and destroy each other? When will they learn, that the peaceable possession of their own country is sufficient for their happiness? When will they be wise enough to give up their false pretensions, to renounce imaginary dominions, and distant possessions, which are often ruinous, or at least cost more than their value? The Spanish empire in Europe is as extensive as that of France, and ten times larger in America; Is it ten times more powerful? Is it even as powerful as if this bold and great nation were limited to derive from its own happy country all the benefits which it could furnish? Have not the British, a people so sensible, and such profound thinkers, committed a great error by extending too far the limits of their colonies? The ancients appear to have had more correct ideas with regard to these establishments. They never projected emigrations till their population was too great, and their territory and commerce were not sufficient to supply their wants. Have not the invasions of barbarians, which we look upon with horror, had causes still more pressing, when they found themselves too numerous in ungrateful, cold, and naked countries, and at the same time surrounded with fertile and cultivated lands, which produced every article they required? But, what quantities of blood, what calamities, what losses, have accompanied and followed these direful conquests?

We shall dwell no longer on the dismal spectacle of those revolutions of death and devastation, which are the genuine effects of ignorance. Let us entertain the agreeable hopes, that the balance, though imperfect, which subsists between cultivated nations, will continue, and become even more stable in proportion as men shall have better notions of their real interest; that they will learn the value of peace and tranquil happiness; that the acquisition of this object will be the chief aim of their ambition; and that Princes will disdain the false glory of conquerors, and despise the little restless vanity of those who excite them to such dreadful commotions.

Let us suppose the world in peace, and take a nearer prospect of the influence of man's power over that of Nature. Nothing appears to be more difficult, not to say impossible, than to oppose the successive cooling of the earth, and to warm the temperature of a climate; yet this feat man can and has performed. Paris and Quebeck are nearly under the same degree of latitude; Paris, therefore, would be as cold as Quebeck, if France and the adjacent countries were as thinly inhabited, and as much covered with wood and water as the territories in the neighbourhood of Canada. The draining, clearing and peopling a country, will give it a warmth which will continue for some thousand years; and this fact will prevent the only reasonable objection which can be made against my opinion, that the earth is gradually cooling.

According to your system, it may be said, the whole earth must be cooler now than it was two thousand years ago: but tradition proves the contrary. France and Germany formerly produced rain-deer, lynxes, bears, and other animals which have since retired to more northerly regions. This progress is very different from what you maintain, namely, from north to south. Besides, history informs us, that the river Seine was annually frozen during a part of the winter. Are not these facts a direct contradiction to the gradual cooling of the earth? They would, I acknowledge, if France and Germany were now in the same state; if we had not cut down the forests, drained the marshes, confined the torrents, directed the rivers, and cleared all the lands which were overgrown with unprofitable plants. But we ought to consider, that the heat of the globe diminishes in an imperceptible manner; that seventy-two thousand years were necessary to cool it to a proper temperature, and that an equal portion of time must elapse before it is so cold as to be unfit for the nourishment of animals and vegetables. We must consider the difference between this slow cooling of the earth and the sudden colds produced in the atmosphere; and we must nevertheless recollect, that the difference between the greatest heat of our summers, and the greatest cold of our winters, exceeds not a thirty-second part. From these considerations it is apparent, that external causes have a much greater influence upon the temperature of every climate than the internal cause, and that, in all those climates where the cold of the superior regions of the air is attracted by moisture, or pushed by the winds towards the surface, the effects of these particular causes are much more powerful than that produced by the general cause. Of this we shall give an example which will remove every doubt, and at the same time obviate every similar objection.

In the immense territories of Guiana, which are covered with thick forests, where the sun can hardly penetrate, where great tracts of country are overflowed with water, where the rivers are very near each other, and are neither restrained nor directed, where it rains continually during eight months of the year, the inhabitants, about a century ago, began to clear the country around Cayenne, which is a very small canton of these vast forests. The difference of temperature in this little district is already so perceptible, that the people are too warm during the night; but in all the lands which are covered with wood, the nights are so cold that fires are necessary in the houses. The same effect is produced with regard to the quantity and duration of the rains: they cease sooner, and commence later at Cayenne than in the interior parts of the country; neither are they so heavy, nor so frequent. At Cayenne, there are four months of absolute dryness: but, in the interior parts of the country, the dry season lasts only three months; besides, a daily rain is brought down by the south winds, which is pretty violent. Another circumstance merits attention: it seldom thunders at Cayenne; but in the interior parts, where the clouds are black, thick, and very low, the thunder is violent and very frequent. These facts show, in the clearest manner, that, in this country, the eight months of perpetual rain might be diminished, and the heat greatly augmented, if the forests were cut down, if the waters were restrained, and the rivers properly directed, and if the cultivation of the earth, which supposes the movements of a great number of men and animals, banished that cold and superfluous moisture which is attracted and diffused by the immense quantity of vegetables.

As every action, every movement, produces heat, and as all beings endowed with the faculty of progressive motion, may be considered as so many little fires, it is in proportion to the number of men and animals, that (every thing else being equal) the local temperature of each particular country depends. The former diffuse heat, the latter nothing but cold and moisture. The perpetual use men make of fire adds greatly to the artificial temperature of all populous territories. In Paris, during great colds, the thermometers at the Faubourg Saint-Honoré stand two or three degrees lower than those at the Faubourg Saint-Merceau; because the north wind is heated in passing over the numerous chimneys of that great city. A single forest in any country is sufficient to produce some change in its temperature. Trees attract the cold; by their shade they diminish the heat of the sun; they produce moist vapours that form clouds and fall down in rain, which is always colder from the greater height it descends. When these forests are abandoned to Nature alone, the old trees fall and coldly corrupt; but, when under the dominion of man, they are used as fuel to the element of fire, and become the secondary causes of every particular heat. In meadows, before the herbage is cut down, there are always copious dews, and often small showers of rain, which cease as soon as the grass is carried off. These small rains would become more abundant and more durable, if our meadows, like the savannahs of America, were always covered with the same quantity of herbs, which, instead of diminishing, must increase by the accumulating manure of all those that die and corrupt on the surface.

Many other examples might be given, all concurring to show that man can have an influence on the climate he inhabits, and, in a manner, fix its temperature at any point that may be agreeable to him; and, what is singular, it is more difficult for him to cool than to heat the earth. He is master of the element of fire, which he can augment and propagate at pleasure, but not of the element of cold, which he can neither lay hold of nor communicate. The principle of cold is not a real substance, but a simple privation, or rather diminution of heat; a diminution which ought to be very great in the high regions of the air, and which, at the distance of a league from the earth, converts the aqueous vapours into hail and snow. For the emanations of heat proper to the globe observe the same law as all other physical quantities or qualities which proceed from a common centre; and, as their density decreases in the inverse ratio of the square of the distance, it appears to be certain, that the atmosphere is four times colder at the height of two leagues than at that of one, each point of the earth's surface being considered as a centre. On the other hand, the interior heat of the globe, in every season, is constantly ten degrees above the freezing point. Hence the earth can never be colder than ten degrees above this point, except by the fall of cold matters upon its surface from the superior regions of the air, where the effects of the internal heat of the globe diminish in proportion to the height. Now, the power of man extends not so far. He cannot make cold descend, as he makes heat ascend. He has no other mode of defending himself from the ardour of the sun's rays, but by forming a shade. But it is more easy to cut down the forests of Guiana, in order to heat the humid earth, than to plant trees in Arabia to refresh the burning sands. A single forest, however, in the midst of these parched deserts, would be sufficient to render them more temperate, to attract the waters from the atmosphere, to restore all the principles of fertility to the earth, and, of course, to make man, in these barren regions, enjoy all the sweets of a temperate climate.

It is upon the difference of temperature that the stronger or weaker energies of Nature depend. The growth, and even the production, of all organized beings, are only particular effects of this general cause: hence man, by modifying this cause, may in time destroy what injures him, and give birth to every thing that is agreeable to his feelings. Happy are those countries where all the elements of temperature are balanced, and so fortunately combined as to produce only good effects! But, has any country, from its origin, ever enjoyed this privilege? Is there any country where the power of man has not aided that of Nature, either by attracting or dissipating the waters, by destroying noxious or superfluous vegetables, and by taming and multiplying useful animals: Of three hundred species of quadrupeds, and fifteen hundred species of birds man has selected nineteen or twenty; the elephant, the camel, the horse, the ass, the ox, the sheep, the goat, the hog, the dog, the cat, the lama, the vigogne, the buffalo; the hen, the swan, the guinea hen, the duck, the peacock, the pheasant and pigeon. These twenty species make a greater figure in nature, and are more useful to the earth than all the others: they make a greater figure, because they are directed and prodigiously multiplied by man. By co-operating with him they produce all the benefits which could be expected from a wise distribution of powers in cultivating the earth, in transporting the articles of commerce, in augmenting provisions, in supplying all the wants, and in ministering to the pleasures of their only master who can reward their services by his industry and attention.

Of the small number of animals selected by man, the hen and the hog species, which are the most prolific, are likewise the most generally diffused, as if the aptitude for great multiplication were accompanied with that vigour of constitution which braves every danger or inconveniency arising from difference of climate. The hen and the hog have been found in the most unfrequented regions of the earth, in Otaheite and other southern islands, which are the most remote from any continent, and have till very lately remained for ever unknown. It appears that these species have followed man in all his emigrations. In South America, where none of our animals could possibly arrive, we find the pecari and wild hen, which, though smaller and a little different from the hog and hen of our continent, must be regarded as a species so much allied, that they might easily be reduced to a domestic state. But savage man, having no idea of society, is not solicitous about that of animals. In the regions of South America the savages have no domestic animals. They destroy indifferently the good with the bad species. They select none for the purposes of rearing and multiplying them; while a single fertile species, like that of the *hocco*, which is at their command, would furnish them, with very little attention, more subsistence than they can procure by their laborious and painful huntings.

Thus the first mark of man's civilization is the empire he assumes over the animals: and this first mark of his intelligence becomes afterwards the greatest evidence of his power over nature: for it is only after he subjugates and tames animals, that he is enabled, by their assistance, to change the face of the earth, to convert deserts into fertile ground, and heath into corn. By multiplying useful animals he augments the quantity of life and motion on the surface of the earth; he at the same time improves the whole race of beings, and ennobles himself, by transforming the vegetable into the animal, and both into his own substance, which afterwards diffuses itself by a numerous multiplication. He every where produces plenty of provisions, which is always succeeded by great population. Millions of men exist in the same space which was formerly occupied by two or three hundred savages, and millions of animals where only a few individuals existed. By him, and for his use, all the precious germs are unfolded; the productions of the noblest kinds are alone cultivated; upon the immense tree of fecundity the fruitful branches are alone brought to perfection.

Grain, of which man makes bread, is not the gift of nature, but the fruit of his researches and of his knowledge in the first of all arts. In no quarter of the earth has wild corn been ever found: it is evidently an herb brought to perfection by his care and industry. This precious plant he must have selected out of many thousands. He must have sown and reaped a number of times in order to discover its fertility, which is always proportioned to the manure and culture bestowed upon the soil: and the singular quality possessed by wheat of resisting in its early state the cold of our winters, though like all other annual plants it perishes after yielding its seed, and its no less wonderful qualities of being nutritious and agreeable to all men, to many animals, accommodated to almost every climate, and can be long preserved without corruption, and without losing its powers of reproduction; all these circumstances concur in proving that it is the most happy invention ever discovered by man; and however ancient it may be supposed, it must have been preceded by the art of agriculture founded upon science, and brought to perfection by experience and observation.

If more modern and even recent examples of man's power over the nature of vegetables are required, we have only to compare our pot-herbs, our flowers, and our fruits, with those of the same species as they existed fifty years ago. This comparison may be instantly made, by inspecting the great collection of flowers, which was begun in the time of Gaston d'Orleans, and continued to this day, in the royal garden. We shall then perceive, perhaps with surprise, that the most beautiful flowers of that period, as the ranunculi, pinks, tulips, auricula, &c. would now be rejected, not by florists alone, but by the most vulgar gardeners. These flowers, though then cultivated, were not far removed from their natural state. A single row of petals or flower leaves, long stamina, and hard or disagreeable colours, without variety, and without delicate shades, are the rustic characters of savage nature. Our pot-herbs consisted of a single species of succory, and two of lettuce, both very bad; but we have now more than fifty kinds of lettuce and succory, all of which are good. Our best fruits and nuts, which are so different from those formerly cultivated that they have no resemblance but in the name, must likewise be referred to a very modern date. In general, substances remain, and names change, with times. But in this case names remain and substances are changed. Our peaches, our apricots, our pears, are new productions with ancient names. To remove every doubt upon this subject we have only to compare our flowers and fruits with the descriptions, or rather notices of them, transmitted to us by the Greeks and Romans. All their flowers were single, and all their fruit trees were wild stocks, and their species very ill chosen: their fruits of course were small, dry, sour, and had neither the flavour nor the beauty of ours.

These new and good species originally sprung from the wild kinds; but how many thousand times have their seeds been sown before this happy effect was produced? It was only by sowing and rearing an infinite number of vegetables of the same species that some individuals were recognised to bear better and and more succulent fruit than others; and this first discovery, which supposes much care and observation, would have remained for ever useless, if a second had not been made, which implies an equal degree of genius as the first required of patience; I mean the mode of multiplying by engrafting those precious individuals which unfortunately cannot propagate, or transmit their excellent qualities to their posterity. This fact alone shows that these qualities are purely individual and not specific; for the seeds of these excellent fruits, like the inferior kinds, produce nothing but wild stocks, which are essentially different.

By means of engrafting, however, man has in a manner created secondary species, which he can multiply at pleasure. The bud or small branch, when united to the wild stock, retains that individual quality which it could not transmit by its seed; and in order to produce the same fruit as its original parent, it requires only to be developed. The fruits receive none of the bad qualities of the wild stock; because it has not contributed to their formation: it is not their mother, but their nurse, which only assists their growth by conveying nourishment to them.

In the animal kingdom, most of those qualities which appear to be individual are propagated and transmitted in the same manner as their specific qualities. It was, therefore, more easy for man to have influence upon the nature of animals than upon that of vegetables. Particular races in any species of animals are only constant varieties which are perpetuated by generation. But in the vegetable kingdom there are no races, no varieties so constant, as to be perpetuated by reproduction. In the species of the hen and pigeon a great number of races have been very lately produced, all of which propagate their kinds. In other species we daily rear and improve races by crossing the breeds. From time to time we naturalize and tame foreign or wild species. All these recent examples show, that it was long before man knew the greatness of his power, and that he is not yet fully acquainted with its extent: it depends entirely on the exercise of his intellect. Thus the more he shall observe and cultivate nature, the more expedients he will discover for making her submit, and for drawing from her bosom fresh sources of riches;

without diminishing the inexhaustible treasures of her fertility.

What influence might not man acquire over his own species, if his inclinations were always directed by his intelligence? Who knows to what degree he might improve his moral as well as his physical nature? Is there a single nation who can boast of having arrived at the best of possible governments, a government which would render all men not equally happy, but less unequally miserable, by attending to their preservation, by softening their labours, and sparing their blood by cultivating peace and procuring abundance of provisions: this is the moral end of every society of men who are anxious to improve their condition: and with regard to the physical part of our nature, have the medical and other arts, whose objects are health and preservation, made an equal progress as the arts of destruction invented for the purposes of war and carnage? In all ages it appears that man has reflected deeper, and made more researches concerning evil than good. In every society there is a mixture of both; and, as of all sentiments which affect the multitude fear is the most powerful, great talents in the art of doing mischief were the first which struck the mind of man; he was afterwards occupied with the arts of amusement; and it was not till after long experience in these two means of false honour and unprofitable pleasure, that he at last recognised his true glory to be science, and his true happiness peace.

OF BIRDS IN GENERAL.

INTRODUCTION.

IT is our task now to advert to a very beautiful and loquacious race of animals, that embellish our forests, amuse our walks, and exclude solitude from our shady retirements. From these man has nothing to fear; their pleasures, desires, and even animosities, only serve to enliven the general picture of nature, and give harmony to meditation.

No part of nature appears destitute of inhabitants. The woods, the waters, the depths of the earth, have each their tenants; while the yielding air, and those tracts of seeming space where man could never ascend, until the discovery of balloons, are also passed through by multitudes of the most beautiful beings of the creation.

Every order and rank of animals seems fitted for its station in life; but none more apparently than birds; they share, with the stronger race of quadrupeds, the vegetable spoils of the earth; are supplied with swiftness to compensate their want of force, and have a faculty of ascending the air to avoid that power they cannot oppose.

The birds seem formed entirely for escape; and every part of their anatomy seems calculated for swiftness. As it is designed to rise upon air, all its parts are proportionably light, and expand a large surface without solidity.

Comparative with man the formations of birds seem much ruder and more imperfect; being in general incapable of the docility even of quadrupeds. Indeed, what great degree of sagacity can be expected in animals whose eyes are almost as large as their brain? But, though they fall below quadrupeds in the scale of nature, and are less imitative of human endowments; yet they hold the next rank, and far surpass fishes and insects, both in the structure of their bodies and in their sagacity.

As in mechanics the most curious instruments are generally the most complicated, so it is in anatomy. The body of man presents the greatest variety upon dissection; quadrupeds, less perfectly formed, discover their defects in the simplicity of their conformation; the mechanism of birds is still less complex; fishes are furnished with fewer organs still; while insects, more imperfect than all seem almost to fill up the chasm that separates animal from vegetable nature. Of man, the most perfect animal, there are but three or four species; of quadrupeds, the kinds are more numerous; birds are more various still; fishes yet more; but insects afford so great a variety that they elude the search of the most inquisitive enquirer.

Quadrupeds, as was said, have some distant resemblance in their internal structure with man; but that of birds is quite dissimilar. As they seem chiefly formed to inhabit the regions of air, all their parts are adapted to their situation.

As to the external parts of birds they seem surprisingly adapted for swiftness of motion. The shape of their body is sharp before, to pierce and make way through the air; it then rises by a gentle swelling to its bulk, and falls off in an expansive tail, that helps to keep it buoyant, while the fore parts are cleaving the air by their sharpness. From this conformation they have been compared to a ship making its way through water; the trunk of the body answers to the hold, the head to the prow, the tail to the rudder, and the wings to the oars.

The next thing to admire is, the neat position of the feathers, lying all one way, and answering at once the purposes of warmth, speed, and security. They mostly tend backward, and are laid over one another in an exact and regular order, armed with warm and soft down next the body, more strongly fortified, and curiously closed externally, to fence off the injuries of the weather. But lest the feathers should spoil by their violent attrition against the air, or imbibe the moisture of the atmosphere, the bird is furnished with a gland behind, containing a proper quantity of oil, which can be pressed out by the bird's bill, and laid smoothly over every feather that wants dressing for the occasion. This gland is situated on the rump, and hath an excretory duct; about which grows a small tuft of feathers somewhat like a painter's pencil. When the feathers are shattered or rumpled, the bird, turning its head backwards, with the bill catches hold of the gland; and, pressing it, forces out the oily substance, with which it anoints the disjoined parts of the feathers; and drawing them out with assiduity, places them in due order; by which they unite more closely. Such poultry, however, as live for the most part under cover, are not furnished with so large a stock of this fluid as those birds that reside in the open air. The feathers of a hen, for instance, are pervious to every shower; but swans, geese, ducks, and all such as nature has directed to live upon the water, have their feathers dressed with oil from the first day of their leaving the shell. Thus their stock of fluid is equal to the necessity of its consumption. Their very flesh contracts a flavour from it, which renders it in some so rancid as to make it unfit for food; however, though it injures the flesh, it improves the feathers for all the domestic purposes to which they are usually converted.

Nor are the feathers with which birds are covered less an object of admiration. The shaft of every feather is made proportionably strong; but hollow below for strength and lightness, and above filled with a pith to feed the growth of the beard that springs from the shaft of the feather on either side. All these feathers are placed according to their length and strength, so that the largest and strongest in flight have the greatest share of duty. The beard of the feather is formed with equal contrivance and care. It consists not of one continued membrane; because, if this were broken it could not easily be repaired; but it is composed of many layers, each somewhat in itself resembling a feather, and lying against each other in close conjunction. Towards the shaft of the feather these layers are broad, and of a semicircular form, to serve for strength, and for the closer grafting them one against another when in action. Towards the outer part of the beard these layers grow slender, to be more light. On their under side they are thin and smooth, but their upper outer edge is parted into two hairy edges, each side having a different sort of hairs, broad at bottom and slender and bearded above. By this mechanism the hooked beards of one layer always lie next the straight beards of the next, and so lock and hold each other.

The next object is the wing, the instrument by which flying is performed. In such birds as fly they are usually placed at that part of the body which serves to poise the whole, and support it in a fluid that at first seems so much lighter than itself. They answer to the fore legs in quadrupeds, and at the extremity of this they have a certain finger-like appendix, which is usually called the *bastard wing*. This instrument of flight is furnished with quills, which differ from the common feathers only in their size being larger, and also from their springing from the deeper part of the skin, their shafts lying almost close to the bone. The beards of these quills are broader on one side than on the other, both which contribute to the progressive motion of the bird, and the closeness of the wing. The manner in which most birds avail themselves of these, is first thus; they quit the earth with a bound, in order to have room for flapping with the wing; when they have room for this they strike the body of the air beneath the wing with a violent motion, and with the whole under surface of the same; but to avoid striking the air with equal violence on the upper side as they rise, the wing is instantly contracted; so that the animal rises by the impulse, till it spreads the wing for a second blow. Thus we always see birds rise against the wind, because they have in this way a greater body of air on the under than the upper side of the wing. Large fowls do not rise easily; because they have not sufficient room at first for the motion of their wings, and because the body of air does not lie so directly under the wing as they rise.

In order to move the wings, all birds are furnished with two very strong pectoral muscles, which lie on each side of the breast bone. The pectoral muscles of quadrupeds are trifling in comparison to those of birds. In quadrupeds, as well as in man, the muscles which move the thighs and hinder parts of the body are by far the strongest, while those of the arms are feeble; but in birds, which make use of their wings, the contrary obtains; the pectoral muscles, that move the wings, are of enormous strength, while those of the thighs are weak. By means of these a bird can move its wings with a degree of strength which, when compared to the animal's size, is almost incredible. The flap of a swan's wing would break a man's leg; and a similar blow from an eagle has been known to lay a man dead in an instant. Such is the force of the wing, and such its lightness, as to be inimitable by art. No machines that human skill can contrive are capable of giving such force to so light an apparatus. The art of flying, therefore, that has so fruitlessly been sought after, must, it is feared, for ever be unattainable; since as man increases the force of his flying machine, he must increase its weight also.

In all birds, except nocturnal ones, the head is smaller, and bears less proportion to the body than in quadrupeds, that it may more readily divide the air in flying, and make way for the body, so as to render its passage more easy. Their eyes also are more flat and depressed than in quadrupeds; a circle of small plates of bones, placed scalewise, under the outer coat of the organ, encompasses the pupil on each, to strengthen and defend it from injuries. Besides this, birds have a kind of skin, called the nictitating membrane, with which, like a veil, they can at pleasure cover their eyes, though their eyelids continue open. This membrane takes its rise from the more obtuse corner of the eye, and serves to wipe, cleanse, and probably to moisten its surface. The eyes, though they outwardly appear but small, yet separately each almost equals the brain; whereas in man the brain is more than twenty times larger than the orbit of the eye. Nor is this organ in birds less adapted for vision by a particular expansion of the optic nerve, which renders the impressions of external objects more vivid and distinct.

Thus it follows, that the sense of seeing in birds is infinitely superior to that of other animals. Indeed this piercing sight seems necessary to the creature's support and safety. Were this organ blunter, from the rapidity of the bird's motion, it would be apt to strike against every object in its way; and it could scarcely find subsistence, unless possessed of a power to discern its food from above with astonishing sagacity. A hawk, for instance, perceives a lark at a distance which neither men nor dogs could spy; a kite, from an almost imperceptible height in the clouds, darts down on its prey with unerring aim. The sight of birds, therefore, exceeds what we know in most other animals, and excels them in strength and precision.

All birds want the external ear standing out from the head; they are only furnished with holes that convey sounds to the auditory canal. It is true, indeed, that the horned owl, and one or two more birds, seem to have external ears; but what bears that resemblance are only feathers sticking out on each side of the head, but no way necessary to the sense of hearing. But it is probable, that the feathers encompassing the ear-holes in birds supply the defect of the exterior ear, and collect sounds to be transmitted to the internal sensory. The extreme delicacy of this organ is easily proved by the readiness with which birds learn tunes, or repeat words, and the great exactness of their pronunciation.

The sense of smelling seems not less vivid in the generality of birds. Many of them *wind* their prey at an immense distance, while others are equally protected by this sense against their pursuers. In decoys, where ducks are caught, the men who attend them universally, keep a piece of turf burning near their mouths, upon which they breathe, lest the fowl should smell them, and fly away. This universal practice puts the necessity of it beyond a doubt, and proves the delicacy of the sense of smelling, at least in this species of the feathered tribe.

Let us now view the legs and feet ministering to motion. They are both made light for the easier transportation through the air. The toes in some are webbed, to fit them for the waters; in others they are separate, for the better holding objects, or clinging to trees for safety. Such as have long legs have also long necks, as otherwise they would be incapable of gathering up their food, either by land or water. But it does not hold, that those who have long necks should have long legs, since swans and geese, whose necks are extremely long, have very short legs, and these chiefly employed in swimming.

Thus every external part hitherto noticed appears adapted to the life of the animal; nor are the inward parts less necessary to safety. The bones of every part of the body are light and thin; and all the muscles, except those immediately moving the wings, slight and feeble. The tail, which is composed of quill feathers, serves to counterbalance the head and neck; it guides the animal's flight, like a rudder, and assists it either in its ascent or descent.

If we examine birds internally, we shall find the same wonderful conformation fitting them for a life in air, and increasing the surface by diminishing the solidity. In the first place their lungs, which are commonly called the *sole*, stick fast to the sides of the ribs and back, and can be very little dilated or contracted. But to make up for this, the ends of the branches of the wind-pipe open into them, while these have openings into the cavity of the belly, and convey the air drawn in by breathing into certain receptacles like bladders, running along the length of the body. Nor are these openings difficult to be discerned; for a probe thrust into the lungs of a fowl will easily find a passage into the belly; and air blown into the wind-pipe will be seen to distend the animal's body like a bladder. It is sometimes seen that the wind-pipe makes many convolutions within the body of the bird, and it is then called the *labyrinth;* but of what use these are, or why the wind-pipe should make so many turnings within the body of some birds is a difficulty for which no naturalist has been able to account.

A difference of the wind-pipe often obtains in animals that to all appearance are of the same species. Thus in the tame swan the wind-pipe makes but a straight passage into the lungs; while in the wild swan, which to all external appearance seems the same animal, the wind-pipe pierces through the breast-bone, and there has several turnings, before it comes out again, and goes to enter the lungs. It is not to form the voice that these turnings are found, since the fowls that are without them are vocal; and those, particularly the bird just now mentioned, that have them, are silent. All we are certain of is, that birds have much louder voices, in respect to their bulk, than animals of any other kind; for the bellowing of an ox is not louder than the scream of a peacock.

In these particulars, birds pretty much resemble each other in their internal conformation; but there are some varieties which we should more attentively observe. All birds have, properly speaking, but one stomach; but this is different in different kinds. In all the rapacious kinds, that live upon animal food, as well as in some of the fish-feeding tribe, the stomach is peculiarly formed. The œsophagus in them, is replete with glandulous bodies, which dilate and macerate the food, as it passes into the stomach, which is always large in proportion to the size of the bird, and generally wrapped round with fat, to increase its warmth and powers of digestion.

Graniverous birds, or such as live upon fruits, corn, and other vegetables, have their intestines differently formed from those of the rapacious kind. Their gullet dilates just above the breast-bone, and forms itself into a pouch or bag, called the crop. This is replete with salivary glands, which moisten and soften the grain and other food which it contains. These glands are numerous, with longitudinal openings, which emit a whitish substance. After the dry food of the bird has been macerated a convenient time, it passes into the belly, where instead of a soft, moist stomach, it is ground between two pair of muscles, commonly called the gizzard, covered on the inside with a stony, ridgy coat, and almost cartilaginous. The organs of digestion are in a manner reversed in birds. Beasts grind their food with their teeth, and then it passes into the stomach, where it is softened and digested. On the contrary, birds of this sort first macerate and soften it in the crop, and then it is ground and comminuted in the stomach or gizzard. Birds are also careful to pick up sand, gravel, and other hard substances, to prevent the too violent action of the coats of the stomach against each other.

Most birds have two appendices or blind-guts, which, in quadrupeds, are always found single. Among such birds as are thus supplied, all carnivorous fowl, and all birds of the sparrow kind, have very small and short ones; water-fowl, and birds of the poultry kind, the longest of all.—There is still another appendix observable in the intestines of birds, resembling a little worm, which is nothing more than the remainder of that passage by which the yolk was conveyed into the guts of the young chicken, while yet in the egg and under incubation.

The outlet of that duct which conveys the bile into the intestines is, in most birds, a great way distant from the stomach; which may arise from the danger there would be of the bile regurgitating into the stomach in their various rapid motions; wherefore their biliary duct is so contrived, that this regurgitation cannot take place.

All birds, though they want a bladder for urine, have large kidneys and ureters, by which this secretion is made, and carried away by one common canal. 'Birds,' says Harvey, 'as well as serpents, which have spongy lungs, make but little water, because they drink but little.—They therefore have no need of a bladder; but their urine distils down into the common canal, designed for receiving the other excrements of the body. The urine of birds differ from that of other animals: for, as there is usually in urine two parts, one more serous and liquid, the other more thick and gross, which subsides to the bottom; in birds, the last part is most abundant, and is distinguished from the rest by its white or silver colour. This part is found not only in the whole intestinal canal, but is seen also in the whole channel of the ureters, which may be distinguished from the coats of the kidneys by their whiteness. This milky substance they have in greater plenty than the more thin and serous part; and it is of a middle consistence, between limpid urine and the grosser parts of the fæces. In passing through the ureters, it resembles milk curdled or lightly condensed; and, being cast forth, easily congeals into a chalky crust.'

Birds are subject to few diseases; but there is one which they are subject to, from which quadrupeds are, in a great measure, exempt; this is the annual moulting which they suffer; for all birds whatsoever obtain a new covering of feathers once a year, and cast the old. During the moulting season, they appear disordered; those most remarkable for their courage, lose all their fierceness; and such as are of a weakly constitution, often expire under this operation. No feeding can maintain their strength; they all cease to breed at this season; that nourishment which goes to the production of the young is wholly absorbed by the demand required for supplying the nascent plumage.

This moulting time may be artificially accelerated; and those who have the management of singing-birds, frequently put their secret in practice. They inclose the bird in a dark cage, where they keep it warm, and throw the poor little animal into an artificial fever; this produces the moult; his old feathers fall before their time, and a new set take place, more brilliant and beautiful than the former. They add, that it mends the bird's singing, and increases its vivacity; but scarcely one bird in three survives the operation.

The moulting season commonly obtains from the end of summer to the middle of autumn. The bird continues to struggle with this malady during the winter;

and Nature has kindly provided, that when there are the fewest provisions, that then the animal's appetite shall be least craving. At the beginning of spring, when food begins again to be plentiful, the animal's strength and vigour return. It is then that the abundance of provisions, aided by the mildness of the season, incite it to love, and all Nature seems teeming with life, and disposed to continue it.

Having treated of birds in general, it is necessary to say something of the generation, nestling, and incubation of the feathered tribe.

The return of spring is the beginning of pleasure. Those vital spirits, which seemed locked up during the winter, then begin to expand; vegetables and insects supply abundance of food; and the bird, having more than a sufficiency for its own subsistence, is impelled to transfuse life, as well as maintain it. Those warblings, which had been hushed during the colder seasons, now begin to animate the fields; every grove and bush resounds with the challenge of anger, or the call of allurement. This delightful concert of the grove is no way studied for man's amusement: it is usually the call of the male to the female; his efforts to soothe her during the times of incubation; or it is a challenge between two males, for the affections of some common favourite.

By this call birds begin to pair at the approach of spring, and provide for the support of a future progeny. The loudest notes are usually from the male, while the hen seldom expresses her consent, but in a short, interrupted twittering. This compact, at least for the season, holds with unbroken faith; many birds live with inviolable fidelity together for a constancy; and when one dies, the other is always seen to share the same fate soon after. Were it possible to compare sensations, the male of all wild birds seems as happy in the young brood as the female; and all his former caresses seem aimed at that important occasion when they are both to become parents, and educate a progeny of their own producing. The pleasures of love appear dull in their effects, when compared to the interval immediately after the exclusion of their young. They both are then transported with pleasure; every action testifies their pride, importance, and tender solicitude.

When the business of fecundation is performed, the female then begins to lay. Such eggs as have been impregnated are prolific: and such as have not continue barren, and are only addled by incubation. Previous, however, to laying, the work of nestling becomes the common care; and this is performed with no small degree of assiduity and design. It has been asserted, that birds of one kind always make their nests in the same manner, and of the same materials; but the truth is, that they vary this as the materials, places, or climates, happen to differ. Where the eggs are numerous, it is incumbent to make the nest warm, that the animal heat may be diffused to them all. With regard to climate, water-fowl, that with us make a very slovenly nest, are more exact in the colder regions of the north. They there take every precaution to make it warm; and some kinds strip down from their breasts, to line it with greater security.

In general, however, every bird resorts to hatch in those climates or places where its food is found in greatest plenty; and always in that season when provisions are in the greatest abundance. The large birds, and those of the aquatic kinds, choose places as remote from man as possible, as their food is in general different from that which is cultivated by human labour. Some birds, which have only the serpent to fear, build their nests depending from the end of a small bough, and form the entrance from below; being thus secured either from the serpent or the monkey tribes. But all the little birds which live upon fruits and corn, and that are too often unwelcome intruders upon the fruits of human industry, in making their nests, use every precaution to conceal them from man. On the other hand, the great birds, remote from human society, use every precaution to render theirs inaccessible to wild beasts or vermin.

Nothing can exceed the patience of birds while hatching; neither the calls of hunger, nor the near approach of danger, can drive them from the nest. They are often fat upon beginning to sit, yet before incubation is over, the female is usually wasted to skin and bone. Ravens and crows, while the females are sitting, take care to provide them with food; and this in great abundance. But it is different with most of the smaller kinds: during the whole time, the male sits near his mate upon some tree, and soothes her by his singing; and often when she is tired takes her place, and patiently continues upon the nest till she returns. Sometimes, however, the eggs acquire a degree of heat too much for the purposes of hatching; in such cases, the hen leaves them to cool a little, and then returns to sit with her usual perseverance.

So great is the power of instinct, in animals of this class, that they seem driven from one appetite to another, and continue almost passive under its influence. Reason we cannot call it, since the first dictates of that principle would be self-preservation:—'Take a brute,' says Addison, 'out of his instinct, and you find him wholly deprived of understanding. With what caution,' continues he, 'does the hen provide herself a nest in places unfrequented, and free from noise and disturbance! When she has laid her eggs in such a manner that she can cover them, what care does she take in turning them frequently, that all parts may partake of the vital warmth! When she leaves them to provide for her necessary sustenance, how punctually does she return before they have time to cool, and become incapable of producing an animal! In the summer you see her giving herself greater freedoms, and quitting her care for above two hours together: but in winter, when the rigour of the season would chill the principles of life, and destroy the young one, she grows more assiduous in her attendance, and stays away but half the time. When the birth approaches, with how much nicety and attention does she help the chick to break the prison! not to take notice of her covering it from the injuries of the weather, providing it with proper nourishment, and teaching it to help itself; nor to mention her forsaking the nest, if, after the usual time of reckoning, the young one does not make its appearance. A chymical operation could not be followed with greater art or diligence than is seen in hatching a chick, though there are many birds that show an infinitely greater sagacity: yet at the same time the hen, that has all this seeming ingenuity, (which is indeed absolutely necessary for the propagation of the species,) considered in other respects, is without the least glimmerings of thought or common sense: she mistakes a piece of chalk for an egg, and sits upon it in the same manner; she is insensible of any increase or diminution in the number of those she lays, she does not distinguish between her own, and those of another species; and when the birth appears of never so different a bird, will cherish it for her own. A hen followed by a brood of ducks, shall stand affrighted at the edge of the pond, trembling for the fate of her young, which she sees venturing into so dangerous an element. As the different principle which acts in these different animals cannot be termed reason, so when we call it instinct, we mean something we have no knowledge of. It appears to me the immediate direction of Providence; and such an operation of the Supreme Being, as that which determines all the portions of matter to their proper centres.'

The production of the young, as was said, seems to be the great æra of a bird's happiness. Nothing can at that time exceed its spirit and industry: the most timid becomes courageous in the defence of its young. Birds of the rapacious kind, at this season, become more than usually fierce and active. They carry their prey, yet throbbing with life, to the nest, and early accustom their young to habits of slaughter and cruelty. Nor are those of milder nature less busily employed; the little birds discontinue their singing, taken up with more important pursuits of common subsistence.

While the young are yet unfledged, and continue in the nest, the old ones provide them with a regular supply; and feed each of the young in their turn. If they perceive that man has been busy with their nest, or has handled the little ones, they abandon the place by night, and provide their brood a more secure retreat. When the whole family is plumed, and capable of avoiding danger by flight, they are led forth in fine weather, and taught the art of providing for their subsistence. They are shewn where their food lies, and the method of discovering or carrying it away; and then led to the nest, for a day or two longer. At length, when qualified to shift for themselves, the old ones take them abroad, and leading them to the accustomed places, forsake them for the last time; and all future connection is at an end.

Birds, in general, though they have much to fear from man and each other, are seldom scared from their usual haunts. Although they be so perfectly formed for a wandering life, and are supplied with powers to satisfy their appetites, though remote from the object, yet the greatest number remain contented in the districts where they have been bred, and do not exert their desires in proportion to their endowments. The rook, if undisturbed, never desires to leave his native grove; the black-bird still frequents its accustomed hedge; and the red-breast, though seemingly mild, claims a certain district, from whence he seldom moves, but drives out every one of the same species from thence without pity. But perhaps they are excited to migration by no other motives but those of fear, climate, or hunger.

Nothing has more employed the curiosity of mankind than these annual migrations; and yet few subjects continue so much involved in darkness. It is generally believed, that the cause of their retreat from these parts of Europe, is either a scarcity of food at certain seasons, or the want of a secure asylum from the persecution of man during the time of courtship and bringing up their young. Thus the starling, in Sweden, at the approach of winter, finding subsistence no longer in that kingdom, descends every year into Germany; and the hen chaffinches of the same country are seen every year to fly through Holland in large flocks, to pass their winter in a milder climate. Others, with a more daring spirit, prepare for journies that might intimidate even human perseverance. Thus the quails, in spring, forsake the burning heats of Africa for the milder sun of Europe; and, when they have passed the summer with us, steer their flight back to enjoy in Egypt the temperate air, which then begins to be delightful. This, with them, seems a preconcerted undertaking. They unite together in some open place, for some days before their departure, and, by an odd kind of chattering, seem to debate on the method to proceed. When their plan is resolved upon, they all take flight together, and often appear in such numbers, that to mariners at sea, they seem like a cloud that rests upon the horizon. The boldest, strongest, and by far the greatest number, make good their intention; but many there are who grow weary in the way, and drop into the sea, and sometimes upon deck, thus becoming an easy prey to the mariner.

Of the vast quantity of water-fowl that frequent our shores, it is amazing to reflect how few are known to breed here. The cause that principally urges them to leave this country, seems to be not merely the want of food, but the desire of a secure retreat. Our country is too populous for birds so shy and timid as the greatest number of these are.

Of the numerous tribes of the duck kind, we know of no more than five that breed here: the tame swan, the tame goose, the sheldrake, the eider duck, and a few of the wild ducks. The rest contribute to form that amazing multitude of water-fowl which annually repair to the dreary lakes and deserts of Lapland from the more southern countries of Europe. We are not to be astonished, therefore, at the amazing numbers of fowl that descend from these regions at the approach of winter.

This migration from the north usually begins in September, when they quit their retreats, and disperse themselves over all the southern parts of Europe. It is not unpleasing to observe the order of their flight; they generally range themselves in a long line, or they make their march angularly, two lines uniting in the centre like the letter V reversed. The bird which leads at the point seems to cleave the air to facilitate the passage for those which are to follow. When fatigued with this laborious station, it falls back into one of the wings of the file, while another takes its place. With us they make their appearance about the beginning of October, circulate first round our shores, and, when compelled by severe frost, betake themselves to our lakes and rivers. Some, indeed, of the web-footed fowl, of hardier constitutions than the rest, abide the rigours of their northern climate the whole winter; but when the cold reigns there with more than usual severity, they seek for more southern skies. They then repair with the rest for shelter to these kingdoms; so that the diver, the wild swan, and the swallow-tailed sheldrake, visit our coasts but seldom, and that only when compelled by the severity of their winters at home.

It has been often a subject of astonishment, how animals to all appearance so dull and irrational should perform such long journies, should know whither to steer, and when to set out upon such a great undertaking. It is probable that the same instinct which governs their other actions operates here. They rather follow the weather than the country; they steer only from colder or warmer climates into those of an opposite nature; and finding the variations of the air as they proceed in their favour, go on till they find land to repose on.

This seems to be pretty plain; but there is a circumstance attending the migration of swallows which wraps this subject in great obscurity. It is agreed that they are seen migrating into warmer climates, in amazing numbers, at the approach of winter. Their return into Europe is also about the beginning of summer; but we have another account, which serves to prove that numbers of them continue torpid here during the winter, and, like bats, make their retreat into old walls, the hollow of trees, or even sink into the deepest lakes, and find security for the winter season by remaining there in clusters at the bottom. However this latter circumstance may be, their retreat into old walls is well authenticated. The difficulty is to account for this difference in these animals thus variously preparing to encounter the winter. It was supposed that in some of them the blood might lose its motion by the cold, and that thus they were rendered torpid by the severity of the season.

Thus some birds by migrating make an habitation of every part of the earth; but in general every climate has birds peculiar to itself. The feathered inhabitants of the temperate zone are but little remarkable for the beauty of their plumage; but then the smaller kinds make up for this defect by the melody of their voices. The birds of the torrid zone are very bright and vivid in their colours; but they have screaming voices, or are totally silent. The frigid zone, on the other hand, where the seas abound with fish, are stocked with birds of the aquatic kind, in much greater plenty than in Europe; and these are generally clothed with a warmer coat of feathers; or they have large quantities of fat lying underneath the skin, which serves to defend them from the rigours of the climate.

But in all countries birds are a more long-lived class of animals than the quadrupeds or insects of the same climate. The life of man himself is but short, when compared to what some of them enjoy. Swans have been known to live three hundred years; geese are often seen to live fourscore; while linnets, and other little birds, though imprisoned in cages, are often found to reach fourteen or fifteen. How birds, whose age of perfection is much more early than that of quadrupeds, should yet live comparatively so much longer, is not easily to be accounted for.

All birds in general are less than quadrupeds; that is, the greatest of one class far surpass the greatest of the other in magnitude. The ostrich, which is the greatest of birds, bears no proportion to the elephant; and the smallest humming bird, which is the least of the class, is still far more minute than the mouse. In these the extremities of Nature are plainly discernible; and in forming them she appears to have been doubtful in her operations: the ostrich, seemingly covered with hair, and incapable of flight, making near approaches to the quadruped class; while the humming-bird, of the size of an humble bee, with a fluttering motion, seems nearly allied to the insect.

These extremities of this class are rather objects of human curiosity than utility: it is the middle order of birds which man has taken care to propagate and maintain. Of those which he has taken under his protection, and which administer to his pleasures or necessities, the greatest number seem creatures of his formation. The variety of climate to which he consigns them, the food with which he supplies them, and the purposes for which he employs them, produce amazing varieties, both in their colours, shape, magnitude, and the taste of their flesh. Wild birds are, for the most part, of the same magnitude and shape; they still keep the prints of primæval nature upon them; except in a few they generally maintain their very colour; but it is otherwise with domestic animals; they change at the will of man—of the tame pigeon, for instance, it is said that they can be bred to a feather.

As we are thus capable of influencing their form and colour, so also it is frequent to see equal instances of our influencing their habitudes, appetites, and passions. The cock, for instance, is artificially formed into that courage and activity which he is seen to possess; and many birds testify a strong attachment to the hand that feeds them: how far they are capable of instruction is manifest to those who have the care of hawks. But a still more surprising instance of this was seen some time ago in London: a canary bird was taught to pick up the letters of the alphabet, at the word of command, so as to spell any person's name in company; and this the little animal did by motions from its master which were imperceptible to every other spectator. Upon the whole, however, they are inferior to quadrupeds in docility; and seem more mechanically impelled by all the power of instinct.

We shall now take notice of the division of birds.

Though birds are fitted for sporting in air, yet as they find their food upon the surface of the earth, there seems a variety equal to the different aliments with which it tends to supply them. The flat and burning desert, the rocky cliff, the extensive fen, the stormy ocean, as well as the pleasing landscape, have all their peculiar inhabitants. The most obvious distinction of birds is into those that live by land and those that live by water; or into land birds and water fowl.

It is not difficult to distinguish land from water fowl by the legs and toes. All land birds have their toes divided, without any web between them; and their legs and feet serve for the purposes of running, grasping, or climbing. But water fowl have their legs and feet formed for the purposes of wading in water, or swimming on its surface. In those that wade the legs are usually long and naked; in those that swim the toes are webbed together, as we see in the feet of a goose, which serve to drive them forward with greater velocity. The formation, therefore, of land and water fowl is as distinct as their habits: and nature seems to offer us this distribution in methodizing animals of the feathered creation.

But a distinction so comprehensive goes a short way in illustrating the different tribes of so numerous a class. The number of birds already known amounts to above eight hundred; and every person who turns his mind to these kind of pursuits is every day adding to the catalogue. In my distribution of birds, therefore, I shall follow Linnæus in the first sketch of his system; and then leave him, to follow the most natural distinctions, in enumerating the different kinds that admit of a history or require a description.

Linnæus divides all birds into six classes; namely, into birds of the *rapacious kind*, birds of the *pie kind*, birds of the *poultry kind*, birds of the *sparrow kind*, birds of the *duck kind*, and birds of the *crane kind*. The four first comprehend the various kinds of land birds; the two last, those of water fowl.

Birds of the *rapacious kind* constitute that class of carnivorous fowl that live by rapine. He distinguishes them by their beak, which is hooked, strong, and notched at the point; by their legs, which are short and muscular, and made for the purposes of tearing; by their toes, which are strong and nobbed; and their talons, which are sharp and crooked; by the make of their body, which is muscular; and their flesh, which is impure; nor are they less known by their food, which consists entirely of flesh; their stomach, which is membranous; and their manners, which are fierce and cruel.

Birds of the *pie kind* have the bill differing from the former: as in those it resembled a hook, destined for tearing to pieces; in these it resembles a wedge, fitted for cleaving. Their legs are short and strong, for walking; their body slender and impure, and their food miscellaneous. They nestle in trees; and the male feeds the female during incubation.

Birds of the *poultry kind* have the bill a little convex, for the purposes of gathering their food. The upper chap hangs over the lower; their bodies are fat and muscular, and their flesh white and pure. They live upon grain, which is moistened in the crop. They make their nest on the ground, without art; they lay many eggs, and use promiscuous commerce.

Birds of the *sparrow kind* comprehend all that beautiful and vocal class that adorn our fields and groves, and gratify every sense in its turn. Their bills may be compared to a forçeps; their legs are formed for hopping; their bodies are tender; pure in such as feed upon grain, impure in such as live upon insects. They live chiefly in trees; their nests are artificially made, and they are observed to maintain connubial fidelity.

Birds of the *duck kind* use their bills as a kind of strainer to their food; it is smooth, covered with skin, and nervous at the point. Their legs are short, and their feet formed for swimming, the toes being webbed together. Their body is fat, inclined to rancidity. They live in waters, but chiefly build their nests upon land.

With respect to the order of birds that belong to the waters, those of the *crane kind* have the bill formed for searching and examining the bottom of pools; their legs are long, and formed for wading; their toes are not webbed; their thighs are half naked; their body is slender, and covered with a very thin skin; their tail is short, and their flesh savoury. They live in lakes upon animals, and chiefly build their nests upon the ground.

Such is the division of Linnæus; and at first sight it appears natural and comprehensive. But we must not be deceived by appearances; the student, who should imagine he was making a progress in the history of nature, while he was only thus making arbitrary distributions, would be much mistaken. Should he enter deeper into this naturalist's plan, he would find birds the most unlike in nature thrown together into the same class; and find animals joined that entirely differ in climate, in habitudes, in manners, shape, colouring, and size. In such a distribution, for instance, he would find the humming-bird and the raven, the rail and the ostrich, joined in the same family. The only way then to form any idea of the animal whose history he desires to know, is to see it; and very few have an opportunity of doing so. The number of birds is so great, that it might exhaust the patience not only of the writer, but the reader, to examine them all: in the present undertaking it would certainly be impossible. I will therefore now attach myself to a more natural method; and still keeping the general division of Linnæus before me enter into some description of those most worth knowing.

Under one or other class, as I shall treat them, the reader will probably find all the species, and all the varieties that demand his curiosity. When the leader of any tribe is described, and its history known, it will give a tolerable idea of all the species contained under it. It is true, the reader will not thus have his knowledge ranged under such precise distinctions; nor can he be able to say, that the rail is of the ostrich class; but what is more material, he will have a history of the bird he desires to know, or of that which most resembles it in nature.

Before I enter upon a systematic detail, I will beg leave to give the history of three or four birds that do not range well in any system. These, from their great size, are sufficiently distinguishable from the rest; and from their incapacity of flying, lead a life a good deal differing from the rest of the feathered creation. The birds I mean are the ostrich, the cassowary, the emu, the dodo, and the solitaire.

THE OSTRICH.

In beginning with the feathered tribe, the first animal that offers seems to unite the class of quadrupeds and of birds in itself. While it has the general outline and properties of a bird, yet it retains many of the marks of the quadruped. In appearance the ostrich resembles the camel, and is almost as tall; it is covered with a plumage that resembles hair more nearly than feathers, and its internal parts bear as near a similitude to those of the quadruped as of the bird creation. It may be considered, therefore, as an animal made to fill up that chasm in nature which separates one class of beings from another.

The ostrich is the largest of all birds. Travellers affirm that they are seen as tall as a man on horseback; and even some of those that have been brought into England were above seven feet high. The head and bill somewhat resemble those of a duck; and the neck may be likened to that of a swan, but that it is much longer; the legs and thighs resemble those of a hen; though the whole appearance resembles that of a camel. It is usually seven feet high from the top of the head to the ground; but from the back it is only four; the head and neck being above three feet long. From the top of the head to the rump, when the neck is stretched out, it is six feet long, and the tail is about a foot more. One of the wings, without the feathers, is a foot and a half; and being stretched out, with the feathers, is three feet.

The plumage is much alike in all; that is, generally black and white; though some of them are said to be grey. The greatest feathers are at the extremities of the wings and tail, and the largest are generally white. The next row is black and white; and of the small feathers, on the back and belly, some are white and others black. There are no feathers on the sides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half way, is covered with still smaller feathers than those on the belly and back; and those also are of different colours.

All these feathers are of the same kind, and peculiar to the ostrich; for other birds have several sorts, some of which are soft and downy, and others hard and strong. Ostrich feathers are almost all as soft as down, being unfit to serve the animal for flying, and less adapted for a defence against injury. The feathers of other birds have the webs broader on one side than the other, but those of the ostrich have their shaft exactly in the middle. The upper part of the head and neck are covered with a fine white hair, that shines like the bristles of a hog: and in some places there are small tufts of it, consisting of above twelve hairs, which grow from a single shaft about the thickness of a pin.

At the end of each wing there is a kind of spur, almost like the wing of a porcupine. It is an inch long, being hollow and of a horny substance. There are two of these on each wing; the largest of which is at the extremity of the bone of the wing, and the other a foot lower. The neck seems to be more slender in proportion to that of other birds, from its not being furnished with feathers. The skin in this part is of a livid flesh-colour, which some improperly would have to be blue. The bill is short and pointed, and two inches and a half at the beginning. The external form of the eye is like that of a man, the upper eye-lid being adorned with eye-lashes which are longer than those on the lid below. The tongue is small, very short, and composed of cartilages, ligaments, and membranes, intermixed with fleshy fibres. In some it is about an inch long, and very thick at the bottom. In others it is but half an inch, being a little forked at the end.

The thighs are very fleshy and large, being covered with a white skin, inclining to redness, and wrinkled in the manner of a net, whose meshes will admit the end of a finger. Some have very small feathers here and there on the thighs; and others again have neither feathers nor wrinkles. The end of the foot is cloven, and has two very large toes, which, like the leg, are covered with scales. These toes are of unequal sizes. The largest, which is on the inside, is seven inches long, including the claw, which is near three fourths of an inch in length, and almost as broad. The other toe is but four inches long, and without a claw.

The internal parts of this animal are formed with no less surprising peculiarity. At the top of the breast, under the skin, the fat is two inches thick; and on the fore part of the belly, it is as hard as suet, and about two inches and a half thick in some places. It has two distinct stomachs. The first, which is lowermost, in its natural situation somewhat resembles the crop in other birds; but it is considerably larger than the other stomach, and is furnished with strong muscular fibres. The second stomach, or gizzard, has outwardly the shape of the stomach of a man; and, upon opening, is always found filled with a variety of discordant substances: hay, grass, barley, beans, bones, and stones, some of which exceed in size a pullet's egg. The kidneys are eight inches long and two broad, and differ from those of other birds in not being divided into lobes. The heart and lungs are separated by a midriff, as in quadrupeds, and the parts of generation also bear a strong resemblance.

Such is the structure of this animal, forming the shade that unites birds and quadrupeds; and from this structure its habits and manners are peculiar. It is a native of the torrid regions of Africa, and has long been celebrated by those who have mentioned the animals of that region. Its flesh is proscribed in Scripture as unfit to be eaten; and most of the ancient writers describe it as well known in their times. Like the race of the elephant, it is transmitted down without mixture; and has never been known to breed out of that country which first produced it. It seems formed to live among the sandy and burning deserts of the torrid zone; and, as in some measure it owes its birth to their influence, so it seldom migrates into tracts more mild or fertile. As that is the peculiar country of the elephant, the rhinoceros, and camel, so it may readily be supposed capable of affording a retreat to the ostrich. They inhabit, from preference, the most solitary and horrid deserts, where there are few vegetables to clothe the surface of the earth, and where the rain never comes to refresh it. The Arabians assert that the ostrich never drinks; and the place of its habitation seems to confirm the assertion. In these formidable regions, ostriches are seen in large flocks, which to the distant spectator appear like a regiment of cavalry, and have often alarmed a whole caravan. There is no desert, how barren soever, but what is capable of supplying these animals with provision; they eat almost every thing; and these barren tracts are thus doubly grateful, as they afford both food and security. The ostrich is of all animals the most voracious. It will devour leather, glass, hair, iron, stones, or any thing that is given. Nor are its powers of digestion less in such things as are digestible. Those substances which the coats of the stomach cannot soften, pass whole; so that glass, stones, or iron, are excluded as they were devoured. All metals, indeed, which are swallowed by any animal, lose a part of their weight, and often the extremities of their figure, from the action of the juices of the stomach. A quarter pistole, which was swallowed by a duck, lost seven grains of its weight in the gizzard before it was voided; and it is probable that a still greater diminution of weight would happen in the stomach of an ostrich; but such substances seldom remain long enough in the stomach of any animal to undergo so tedious a dissolution. However this be, the ostrich swallows almost every thing presented to it.

In their native deserts, it is probable they live chiefly upon vegetables, where they lead an inoffensive and social life. They lay very large eggs, some of them being above five inches in diameter, and weighing above fifteen pounds. These eggs have a very hard shell, somewhat resembling those of the crocodile, except that those of the latter are less and rounder.

The season for laying depends on the climate where the animal is bred. In the northern parts of Africa, this season is about the beginning of July; in the south, about the latter end of December. These birds are very prolific, and lay generally from forty to fifty eggs at one clutch. It has been reported that the female deposits them in the sand; and, covering them up, leaves them to be hatched by the heat of the climate, and then permits the young to shift for themselves. This is not true: no bird has a stronger affection for her young than the ostrich, nor none watches her eggs with greater assiduity. It happens, indeed, in those hot climates, that there is less necessity for the continual incubation of the female; and she more frequently leaves her eggs, which are in no fear of being chilled by the weather: but though she sometimes forsakes them by day, she always carefully broods over them by night; and Kolben, who has seen great numbers of them at the Cape of Good Hope, affirms that they sit on their eggs like other birds, and that the male and female take this office by turns, as he had opportunities of observing. Nor do they forsake their young after they are excluded the shell. On the contrary they are not able to walk for several days after they are hatched. During this time, the old ones are assiduous in supplying them with grass, and careful to defend them from danger: nay, they encounter every danger in their defence. It was a way of taking them among the ancients, to plant sharp stakes round the ostrich's nest in her absence, upon which she pierced herself at her return. The young, when hatched, are of an ash colour the first year, and covered with feathers all over. But, in time, these feathers drop; and those parts which are covered, assume a different plumage.

The beauty of a part of this plumage, particularly the long feathers that compose the wings and tail, is the chief reason that man has been so active in pursuing this harmless bird to its deserts, and hunting it with no small degree of expense and labour. The ancients used these plumes in their helmets; the ladies of the East make them an ornament in their dress; and, among us, our undertakers and our fine gentlemen still make use of them to decorate their hearses and their hats. Those feathers which are plucked from the animal when alive, are much more valued than those taken when dead; the latter being dry, light, and subject to be worm-eaten.

Besides the value of their plumage, some of the nations of Africa hunt them for their flesh, which they consider a dainty. They sometimes also breed those birds tame, to eat the young ones, of which the female is said to be the greatest delicacy. Some nations have obtained the name of Struthophagi, or Ostrich-eaters, from their fondness for this food; and even the Romans were not averse to it. Apicius gives us a receipt for making sauce for the ostrich; and Heliogabalus is noted for having dressed the brains of six hundred ostriches in one dish; for it was his custom never to eat but of one dish in a day, but that an expensive one. Even among the Europeans now, the eggs of the ostrich are said to be well tasted, and extremely nourishing, but they are too scarce to be fed upon, although a single egg be a sufficient entertainment for eight men.

As the spoils of the ostrich are thus valuable, it is not to be wondered at that man has become their most assiduous pursuer. For this purpose the Arabians train up their fleetest horses, and hunt the ostrich still in view. Perhaps, of all other varieties of the chase, this, though most laborious, is yet most entertaining. As soon as the hunter comes within sight of his prey, he puts on his horse with a gentle gallop, so as to keep the ostrich in sight; yet not so as to terrify him from the plain into the mountains. Of all known animals that make use of their legs in running, the ostrich is by far the swiftest; upon observing himself therefore pursued at a distance, he begins to run at first but gently; either insensible of his danger, or sure of escaping. In this situation he resembles a man at full speed; his wings keep working with a motion correspondent to that of his legs, and his speed would soon elude the view of his pursuers; but, unfortunately for the silly creature, instead of going off in a direct line, he takes his course in circles; while the hunters still make a small course within, relieve each other, meet him at unexpected turns, and keep him thus employed, following it for two or three days together. At last, spent with fatigue and famine, and finding escape impossible, he endeavours to hide himself from his enemies, covering his head in the sand, or the first thicket he meets. Sometimes he attempts to face his pursuers; and, though in general the most gentle animal in Nature, when driven to desperation, he defends himself with his beak, his wings, and his feet. Such is the force of his motion, that a man would be utterly unable to withstand him in the shock.

The Struthophagi have another method of taking this bird; they cover themselves with an ostrich's skin, and passing up an arm through the neck, thus counterfeit all its motions. They thus approach the ostrich, which becomes an easy prey. He is sometimes taken by dogs and nets: but usually by that mentioned above.

When the Arabians have thus taken an ostrich, they cut its throat, and making a ligature below the opening, they shake the bird, as one would rinse a barrel; then taking off the ligature, there runs out from the wound in the throat, a considerable quantity of blood mixed with the fat of the animal; and this is considered as one of the greatest dainties. They next flay the bird; and of the skin, which is strong and thick, sometimes make a kind of vest, which answers the purpose of a cuirass and a buckler.

There are others who, more compassionate or more provident, do not kill their captive, but endeavour to tame it, for the purpose of supplying those feathers which are in so great request. The inhabitants of Dara and Lybia breed up whole flocks of them, and they are tamed with little trouble. But it is not for their feathers alone that they are prized in this domestic state; they are often ridden upon, and used like horses. Moore assures us, that at Joar he saw a man travelling upon an ostrich; and Adanson asserts that at the factory of Podore, he had two ostriches, which were then young, the strongest of which ran swifter than the best English racer, although he carried two negroes on his back. When the animal perceived that it was loaded, it set off running with all its force, and made several circuits round the village; till at length the people were obliged to stop it, by barring up the way.

Parts of this animal is said to be salutary in medicine.

The fat is said to be emollient and relaxing; that while it relaxes the tendons, it fortifies the nervous system; and being applied to the region of the loins, it abates the pains of the stone in the kidney. The shell of the egg powdered, and given in proper quantities, is said to be useful in promoting urine, and dissolving the stone in the bladder. The substance of the egg itself is thought to be peculiarly nourishing: but Galen asserts, that the eggs of hens and pheasants are good to be eaten, those of geese and ostriches are the worst of all.„

THE EMU.

Of this bird, which many call the American ostrich, but little is known. It is an inhabitant of the New Continent; and the travellers who have mentioned it seem to have been more solicitous in proving its affinity to the ostrich, than in describing those peculiarities which distinguish it from others of the feathered creation.

It is chiefly found in Guiana, along the banks of the Oroonoko, in Brasil and Chili, and the forests that border on the mouth of the river Plata. Many other parts of South America were known to have them; but as men multiplied, these large and timorous birds either fell beneath their superior power, or fled from their vicinity.

The emu, though not so large as the ostrich, is only second to it in magnitude. It is the largest bird in the New Continent; and generally found to be six feet high, measuring from its head to the ground. Its legs are three feet long; and its thigh nearly as thick as that of a man. The toes differ from those of the ostrich; as there are three in the American bird, and but two in the former. Its neck is long, its head small, and the bill flatted, like that of the ostrich; but in other respects it more resembles a cassowary, which will be described hereafter. The form of the body appears round; the wings are short and unfitted for flying, and it wants a tail. It is covered from the back and rump with long feathers, which fall backward, and cover the anus; these feathers are grey upon the back, and white upon the belly. It goes swiftly, and seems assisted in its motion by a kind of tubercle behind, like an heel, upon which, on plain ground, it treads securely: in its course it uses an odd kind of action, lifting up one wing, which it keeps elevated for a time; till letting it drop, it lifts up the other. The emu runs with such swiftness that the fleetest dogs are thrown out in the pursuit. One of them, finding itself surrounded by the hunters, darted among the dogs with such fury that they made way to avoid its rage: and it escaped, by its velocity, to the mountains.

As this bird is but little known, so travellers have given a loose to their imaginations in describing some of its actions, which could not be easily contradicted. This animal, says Nierenberg, is very peculiar in the hatching of its young. The male compels twenty or thirty of the females to lay their eggs in one nest; he then, when they have done laying, chaces them away, and places himself upon the eggs; but he takes a singular precaution of laying two of the number aside, which he does not sit upon. When the young ones come forth, these two eggs are addled; which the male having forseen, breaks one, and then the other, upon which multitudes of flies are found to settle; and these supply the young brood with provisions, till they are able to shift for themselves.

When the young ones are hatched, they are familiar, and follow the first person they meet. I have been followed myself, says Wafer, by many of these young ostriches; which at first are harmless and simple: but as they grow older they become more cunning and distrustful; and run so swift, that a greyhound can scarcely overtake them. Their flesh in general is good; especially if they be young. It would not be difficult to rear up flocks of these animals tame, particularly as they are so familiar: and they might be found to answer domestic purposes, like the hen or the turkey. Their maintenance could not be expensive, if, as Narborough says, they live upon grass.

THE CASSOWARY.

The cassowary is a bird which was first brought into Europe by the Dutch, from Java, in the East Indies, where it is only to be found. Next to the preceding it is the largest and heaviest of the feathered species.

The cassowary, though not so large as the former, appears more bulky to the eye; its body being nearly equal, and its neck and legs much thicker and stronger in proportion; this conformation gives it an air of strength and force, which the fierceness of its countenance conspires to render formidable. It is five feet and a half long, from the point of the bill to the extremity of the claws. The legs are two feet and a half high, from the belly to the end of the claws. The head and neck together are a foot and a half; and the largest toe, including the claw, is five inches long. The claw alone of the least toe is three inches and a half in length. The wing is so small that it does not appear; it being hid under the feathers of the back. In other birds a part of the feathers serve for flight, and are different from those that serve for merely covering; but in the cassowary, all the feathers are of the same kind, and outwardly of the same colour. They are generally double, having two long shafts, which grow out of a short one, which is fixed in the skin. Those that are double are always of an unequal length; some being fourteen inches long; while others are not above three. The beards that adorn the stem or shaft are, from about half way to the end, very long, and as thick as a horse hair, without being sub-divided into fibres. The stem or shaft is flat, shining, black, and knotted below; and from each knot there proceeds a beard; likewise the beards at the end of the large feathers are perfectly black; and towards the root of a grey tawny colour; shorter, more soft, and throwing out fine fibres like down; so that nothing appears except the ends, which are hard and black; because the other part, composed of down, is quite covered. There are feathers on the head and neck; but they are so short and thinly sown, that the bird's skin appears naked, except towards the hinder part of the head, where they are a little longer. The feathers which adorn the rump are thick; but do not differ in other respects from the rest, excepting being longer. The wings, when they are deprived of their feathers, are three inches long, and the feathers are like those on other parts of the body. The ends of the wings are adorned with five prickles, of different lengths and thickness, which bend like a bow: these are hollow from the roots to the points, having only a slight substance within, which all quills have. The longest of these prickles is eleven inches; and it is a quarter of an inch in diameter at the root, being thicker there than towards the extremity; the point seems broken off.

The part, however, which most distinguishes this animal is the head; this, though small, like that of an ostrich, does not fail to inspire some degree of terror. It is bare of feathers, and is in a manner armed with an helmet of horny substance, that covers it from the root of the bill to nearly half the head backwards. This helmet is black before and yellow behind. Its substance is very hard, being formed by the elevation of the bone of the skull; and it consists of several plates, one over another, like the horn of an ox. Some have supposed that this was shed every year with the feathers; but the most probable opinion is, that it only exfoliates slowly like the beak. To the peculiar oddity of this natural armour may be added the colour of the eye in this animal, which is a bright yellow, and the globe being above an inch and a half in diameter, gives it an air equally fierce and extraordinary. At the bottom of the upper eye-lid there is a row of small hairs, over which there is another row of black hair, which looks like an eye-brow. The lower eye-lid, the largest of the two, is furnished with plenty of black hair. The hole of the ear is large and open, being covered with small black feathers. The sides of the head, about the eye and ear, being destitute of any covering, are blue, except the middle of the lower eye-lid, which is white. The part of the bill which answers to the upper jaw in other animals is hard at the edges above, and the extremity of it like that of a turkey-cock. The end of the lower mandible is slightly notched, and the whole is of a greyish brown, except a green spot on each side. As the beak admits a wide opening, this contributes to the bird's menacing appearance. The neck is of a violet colour, inclining to that of slate: and it is red behind in several places, but chiefly in the middle. About the middle of the neck before, at the rise of the large feathers, there are two processes formed by the skin, which resemble somewhat the gills of a cock, but that they are blue as well as red. The skin which covers the fore part of the breast, on which this bird leans and rests, is hard, callous, and without feathers. The thighs and legs are covered with feathers, and are extremely thick, strong, straight, and covered with scales of several shapes; but the legs are thicker a little above the foot than in any other place. The toes are likewise covered with scales, and are but three in number; for that which should be behind is wanting. The claws are of a hard solid substance, black without and white within.

The internal parts are equally remarkable. The cassowary unites with the double stomach of animals that live upon vegetables the short intestines of those that live upon flesh. The intestines of the cassowary are thirteen times shorter than those of the ostrich. The heart is very small, being but an inch and a half long, and an inch broad at the base. Upon the whole, it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the swiftness of a courser.

Thus formed for hostility, for terrifying others, and for its own defence, it might be expected that the cassowary was one of the most fierce and terrible animals of the creation. But nothing is so opposite to its nature, or different from the life it is contented to lead. It never attacks others; and instead of the bill, when attacked, it rather makes use of its legs, and kicks like a horse, or runs against its pursuer, beats him down, and treads him to the ground.

The manner of going of this animal is not less extraordinary than its appearance. Instead of going directly forward, it seems to kick up behind with one leg, and then making a bound onward with the other, it goes with such velocity, that the swiftest racer would be left behind.

The same degree of voraciousness which we perceive in the ostrich obtains as strongly here. The cassowary swallows every thing that comes within the capacity of its gullet. The Dutch assert that it can devour not only glass, iron, and stones, but even live or burning coals, without testifying fear, or feeling injury. It is said, that the passage of food through its gullet is performed so speedily, that the very eggs which it has swallowed whole pass through it unbroken, in the same form they went down. In fact, the alimentary canal of this animal is extremely short; and it may happen that many kinds of food are indigestible in its stomach, as wheat or currants are to man when swallowed whole.

The cassowary's eggs are of a gray ash colour, inclining to green. They are not so large nor so round as those of the ostrich. They are marked with a number of little tubercles of a deep green, and the shell is not very thick. The largest of these is found to be fifteen inches round one way, and about twelve the other.

The southern parts of the most eastern Indies seem to be the natural climate of the cassowary. His domain, if we may so call it, begins where that of the ostrich terminates. The latter has never been found beyond the Ganges; while the cassowary is never seen nearer than the islands of Banda, Sumatra, Java, the Molucca Islands and the corresponding parts of the continent. Yet even here this animal seems not to have multiplied in any considerable degree, as we find one of the kings of Java making a present of one of these birds to the captain of a Dutch ship, considering it as a very great rarity. The ostrich, that has kept in the desert and unpeopled regions of Africa, is numerous, and the unrivalled tenant of its own inhospitable climate. But the cassowary, that is the inhabitant of a more peopled and polished region, is growing scarcer every day; for, as man multiplies, the savage animals fly from him: at his approach they quit their ancient habitations, how adapted soever they may be to their natures, and seek a more peaceable though barren retreat; where they willingly exchange plenty for freedom; and encounter the dangers of famine to avoid the oppressions of an unrelenting destroyer.

THE DODO.

Mankind have generally made swiftness the attribute of birds; but the dodo has no title to this distinction. Instead of exciting the idea of swiftness by its appearance, it seems to strike the imagination as a thing the most unwieldy and inactive of all nature. Its body is massive, almost round, and covered with grey feathers; it is just barely supported upon two short thick legs, like pillars, while its head and neck rise from it in a manner truly grotesque. The neck, thick and pursy, is joined to the head, which consists of two great chaps, that open far behind the eyes, which are large, black, and prominent; so that the animal, when it gapes, seems to be all mouth. The bill, therefore, is of an extraordinary length, not flat and broad, but thick, and of a bluish white, sharp at the end, and each chap crooked in opposite directions. They resemble two pointed spoons that are laid together by the backs.—From all this results a stupid and voracious physiognomy; which is still more increased by a bordering of feathers round the root of the beak, and which give the appearance of a hood or cowl, and finish this picture of stupid deformity. Bulk, which in other animals implies strength, in this only contributes to inactivity. The ostrich or the cassowary, are no more able to fly than the Dodo; but they supply that defect by their speed in running. The dodo seems weighed down by its own heaviness, and has scarcely strength to urge itself forward. It seems among birds what the sloth is among quadrupeds, an unresisting thing, equally incapable of flight or defence. It is furnished with wings, covered with soft ash-coloured feathers, but they are too short to assist it in flying. It is furnished with a tail, with a few small curled feathers; but this tail is disproportioned and displaced. Its legs are too short for running, and its body too fat to be strong.

This bird is a native of the Isle of France; and the Dutch who first discovered it there, called it, in their language, the nauseous bird, as well from its disgusting figure, as from the bad taste of its flesh. However, succeeding observers contradict this report, and assert that its flesh is good and wholesome. It is a silly bird, as may be supposed from its figure, and is easily taken. Three or four dodos are enough to dine a hundred men.

Whether the dodo be the same bird with that which some have described under the bird of Nazareth, is uncertain. The country from whence they both come is the same; their incapacity of flying is the same; the form of their wings and body are similar; but the chief difference is in the colour of the feathers, which in the female of the bird of Nazareth are said to be very beautiful; and in the length of their legs, which in the dodo are short, in the other are long.

OF RAPACIOUS BIRDS IN GENERAL.

In all the classes of nature there seems to obtain a general resemblance. As among quadrupeds, a part were seen to live upon the vegetable productions of the earth, and another part upon the flesh of each other; so among birds, some live upon vegetable food, and others by rapine, destroying all such as want force or swiftness to procure their safety. By thus peopling the woods with animals of different dispositions, Nature has wisely provided for the multiplications of life; since could we suppose that there were as many animals produced as there were vegetables to sustain them, there might still be other animals formed, which could find sustenance by feeding upon such of the vegetable feeders as happened to fall by the course of nature.

In varying the appetites of animals nature has varied the form of the animal; and while she has given some a passion for animal food, she has furnished them with powers to obtain it. All land-birds of the rapacious kinds are furnished with a large head, and a strong, crooked beak, notched at the end, for the purpose of tearing their prey. They have strong, short legs, and sharp, crooked talons, for the purposes of seizing it. Their bodies are formed for war, being fibrous and muscular; and their wings for swiftness of flight, being well feathered and expansive. The sight of such as prey by day is astonishingly quick; and such as ravage by night can see objects in the dark with extreme precision.

Their internal parts are equally formed for the food they seek for. Their stomach is simple and membranous, and wrapt in fat to increase the powers of digestion; and their intestines are short and glandular. As their food is succulent and juicy, they want no length of intestinal tube to form it into proper nourishment. Their ood is flesh; which does not require a slow digesion to be converted into a similitude of substance to heir own.

Thus formed for war, they lead a life of solitude and apacity. They inhabit by choice the most lonely places nd the most desert mountains. They make their nests n the clefts of rocks, and on the highest and most inacessible trees of the forest. Whenever they appear in the ultivated plain or the warbling grove, it is only for the urposes of depredation; and are gloomy intruders on he general joy of the landscape. They spread terror herever they approach; all the variety of music which ut a moment before enlivened the grove, at their appearing is instantly at an end: every order of lesser irds seek for safety, either by concealment or flight; nd some are even driven to take protection with man, o avoid their less merciful pursuers.

It would indeed be fatal to all the smaller race of irds, if, as they are weaker than all, they were pursued y all; but it is contrived wisely for their safety, that every order of carnivorous birds seek only for such as are of the size most approaching their own. The eagle flies at the bustard or the pheasant; the sparrow hawk pursues the thrush and the linnet. Nature has provided that each species should make war only on such as are furnished with adequate means of escape. The smallest birds avoid their pursuers by the extreme agility rather than the swiftness of their flight; for every order would soon be at an end, if the eagle, to its own swiftness of wing, added the versatility of the sparrow.

Another circumstance which tends to render the tyranny of these animals more supportable is, that they are less fruitful than other birds; breeding but a few at a time. Those of the larger kinds seldom produce above four eggs, often but two; those of the smaller kinds, never above six or seven. The pigeon, it is true, which is their prey, never breeds above two at a time; but then she breeds every month in the year. The carnivorous kinds only breed annually, and of consequence their fecundity is small in comparison.

As they are fierce by nature, and difficult to be tamed, so this fierceness extends to their young, which they force from the nest sooner than birds of the gentler kind. Other birds seldom forsake their young till able completely to provide for themselves; the rapacious kinds expel them from the nest at a time when they should protect and support them. This proceeds from the necessity of providing for themselves. All animals that are obliged to live upon flesh, and support themselves by prey, though mild when young, soon become fierce and mischievous, by the habit of using those arms with which they are supplied by nature. As it is only by the destruction of other animals that they can subsist, they become more furious every day; and even the parental feelings are overpowered in their general habits of cruelty. If the power of obtaining a supply be difficult, the old ones soon drive their brood from the nest to shift for themselves, and often destroy them in a fit of fury caused by hunger.

Another effect of this natural and acquired severity is, that almost all birds of prey are unsociable. It has long been observed by Aristotle, that all birds with crooked beaks and talons are solitary: like quadrupeds of the cat kind, they lead a lonely, wandering life, and are united only in pairs, by that instinct which overpowers their rapacious habits of enmity with all other animals. As the male and female are often necessary to each other in their pursuits, so they sometimes live together; but except at certain seasons they most usually prowl alone; and, like robbers, enjoy in solitude the fruits of their plunder.

All birds of prey are remarkable for one singularity, for which it is not easy to account. All the males of these birds are about a third less, and weaker than the females, contrary to what obtains among quadrupeds, for the males are with them always the largest and the boldest; from thence the male is called by falconers a *tercel;* that is, a tierce or third less than the other. The reason of this difference cannot proceed from the necessity of a larger body in the female for the purposes of breeding, and that her volume is thus increased by the quantity of her eggs; for in other birds, that breed much faster, and that lay in much greater proportion, such as the hen, the duck, or the pheasant, the male is by much the largest of the two.

Whatever be the cause, certain it is, that the females are of greater size, more beautiful and lovely for shape and colours, stronger, more fierce and generous, than the males; whether it may be that it is necessary for the female to be thus superior, as it is incumbent upon her to provide, not only for herself, but her young ones also.

These birds, like quadrupeds of the carnivorous kind, are all lean and meagre. Their flesh is stringy and ill-tasted, soon corrupting, and tinctured with the flavour of that animal food upon which they subsist.

Of land birds of a rapacious nature there are five kinds. The eagle kind, the hawk kind, the vulture kind, the horned, and the screech-owl kind. The distinctive marks of this class are taken from their claws and beak: their toes are separated; their legs are feathered to the heel; their toes are four in number, three before, one behind; their beak is short, thick, and crooked.

The eagle kind is distinguished from the rest by his beak, which is straight till towards the end, when it begins to hook downwards.

The vulture kind is distinguished by the head and neck; he is without feathers.

The hawk kind by the beak; being hooked from the very root.

The horned owl by the feathers at the base of the bill standing forwards; and by some feathers on the head that stand out, resembling horns.

The screech-owl, by the feathers at the base of the bill standing forward, and being without horns.——A description of one in each kind will serve for all the rest.

THE EAGLE AND ITS AFFINITIES.

The golden eagle is the largest and noblest of all those birds that have received the name of eagle. It weighs above twelve pounds. Its length is three feet: the extent of its wings, seven feet four inches; the bill is three inches long, and of a deep blue colour; and the eye of a hazel hue. The sight and sense of smelling are very acute. The head and neck are clothed with narrow sharp-pointed feathers, of a deep brown, bordered with tawny; but those on the crown of the head, in very old birds, turn grey. The whole body, above as well as beneath, is of a dark brown; and the feathers of the back are finely clouded with a deeper shade of the same. The wings, when clothed, reach to the end of the tail. The quill feathers are of a chocolate colour, the shafts white. The tail is of a deep brown, irregularly barred and blotched with an obscure ash-colour, and usually white at the roots of the feathers. The legs are yellow, short, and strong, being three inches in circumference, and feathered to the very feet. The toes are covered with scales, and armed with formidable claws, the middle of which are two inches long.

In the rear of this terrible bird follow the *ring tailed eagle*, the *common eagle*, the *bald eagle*, the *white eagle*, the *kough-footed eagle*, the *erne*, *the black eagle*, the *osprey*, the *sea eagle*, and the *crowned eagle*. These, and others that might be added, form different shades in this fierce family; but have all the same rapacity, the same general form, the same habits, and the same manner of bringing up their young.

In general, these birds are found in mountainous and ill-peopled countries, and breed among the loftiest cliffs. They choose those places which are remotest from man, upon whose possessions they seldom make their depredations, being contented rather to follow the wild game in the forest, than to risque their safety to satisfy their hunger.

This fierce animal may be considered among birds as the lion among quadrupeds; and it is not till after having been long provoked by the cries of the rook or the magpie, that this generous bird thinks fit to punish them with death: the eagle also disdains to share the plunder of another bird; and will take up with no other prey but that which he has acquired by his own pursuits. How hungry soever he may be, he never stoops to carrion; and when satiated, he never returns to the same carcass, but leaves it for other animals less delicate than he. Solitary, like the lion, he keeps the desert to himself alone; it is as extraordinary to see two pair of eagles in the same mountain, as two lions in the same forest. They keep separate, to find a more ample supply; and consider the quantity of their game as the best proof of their dominion. Nor does the similitude of these animals stop here: they have both sparkling eyes, and nearly of the same colour; their claws are of the same form, their breath equally strong, and their cry equally loud and terrifying. Bred both for war, they are enemies of all society: alike fierce, proud, and incapable of being easily tamed. It requires great patience and much art to tame an eagle; and even though taken young, and brought under by long attendance, yet still it is a dangerous domestic, and often turns its force against its master. When brought into the field for the purposes of fowling, the falconer is never sure of its attachment: that innate pride, and love of liberty, still prompt it to regain its native solitudes; and the moment the falconer sees it, when let loose, first stoop towards the ground, and then rise perpendicularly into the clouds, he gives up all his former labour for lost; quite sure of never beholding his late prisoner again. Sometimes, however, they are brought to have an attachment for their feeder; they are then highly serviceable, and liberally provide for his pleasures and support. When the falconer lets them go from his hand, they play about and hover round him till their game presents, which they see at an immense distance, and pursue with certain destruction. Of all animals the eagle flies highest; and from thence the ancients have given him the epithet of *the bird of heaven.* Of all birds he has the quickest eye; but his sense of smelling is inferior to that of the vulture. He never pursues, therefore, but in sight; and when he has seized his prey, he stoops from his height, as if to examine its weight, always laying it on the ground before he carries it off. As his wing is very powerful, yet as he has but little suppleness in the joints of the leg, he finds it difficult to rise when down; and if not instantly pursued he finds no difficulty in carrying off geese and cranes. He also carries away hares, lambs, and kids; and often destroys fawns and calves, to drink their blood, and carries a part of their flesh to his retreat. Even infants, when left unattended, have been destroyed by these rapacious creatures, which probably gave rise to the fable of Ganymede's being snatched up by an eagle to heaven.

An instance is recorded in Scotland of two children being carried off by eagles; but fortunately they received no hurt by the way; and the eagles being pursued, the children were restored unhurt out of the nests to the affrighted parents.

The eagle is thus at all times a formidable neighbour; but peculiarly when bringing up its young. It is then that the female, as well as the male, exert all their force and industry to supply their young. Smith, in his History of Kerry, relates, that a poor man in that county got a comfortable subsistence for his family, during a summer of famine, out of an eagle's nest, by robbing the eaglets of food, which was plentifully supplied by the old ones. He protracted their assiduity beyond the usual time, by clipping the wings, and retarding the flight of the young; and very probably also, as I have known myself, by so tying them as to increase their cries, which is always found to increase the parent's dispatch to procure them provision. It was luckily, however, that the old eagles did not surprise the countryman as he was thus employed, for their resentment might have been dangerous.

It happened some time ago, in the same county, that a peasant resolved to rob the nest of an eagle that had built in a small island in the lake of Killarney. He accordingly stripped, and swam in upon the island while the old ones were away; and robbing the nest of its young, he was preparing to swim back, with the eaglets tied in a string; but while he was yet up to his chin in the water, the old eagles returned, and missing their young, quickly fell upon the plunderer, and in spite of all his resistance, killed him with their beaks and talons.

In order to extirpate these birds there is a law in the Orkney Islands which entitles any person that kills an eagle to a hen out of every house in the parish in which the bird is killed.

The nest of the eagle is usually built in the most inaccessible cliff of the rock, and often shielded from the weather by some jutting crag that hangs over it. But sometimes it is wholly exposed to the winds, as well sideways as above; for the nest is flat, though built with great labour. It is said, that the same nest serves the eagle during life; and indeed the pains bestowed in forming it seems to argue as much. One of these was found in the Peak of Derbyshire; which Willoughby thus describes: 'It was made of great sticks resting one 'end on the edge of a rock, the other on two birch 'trees. Upon these was a layer of rushes, and over 'them a layer of heath, and upon the heath rushes again; 'upon which lay one young one, and an addle egg; and 'by them a lamb, a hare, and three heath-poults. The 'nest was about two yards square, and had no hollow in 'it. The young eagle was of the shape of a goshawk, 'of almost the weight of a goose, rough footed, or fea'thered down to the foot, having a white ring about the 'tail.' Such is the place where the female eagle deposits her eggs; which seldom exceed two at a time in the larger species, and not above three in the smallest. It is said that she hatches them for thirty days; but frequently, even of this small number of eggs a part is addled; and it is extremely rare to find three eaglets in the same nest.

The plumage of the eaglets is not so strongly marked as when they come to be adult. They are at first white; then inclining to yellow; and at last of a light brown. Age, hunger, long captivity, and diseases make them whiter. It is said, they live above a hundred years; and that they at last die, not of old age, but from the beaks turning inward upon the under mandible, and thus preventing their taking food. They are equally remarkable, says Mr. Pennant, for their longevity, and for their power of sustaining a long absence from food. One of this species, which had been a considerable number of years in the possession of Mr. Owen Holland, of Conway, lived thirty-two years with the gentleman who made him a present of it; but what its age was when the latter received it from Ireland, is unknown. The same bird also furnishes a proof of the truth of the other remark; having once, through the neglect of servants, endured hunger for twenty-one days without any sustenance whatever.

Those eagles which are kept tame, are fed with every kind of flesh, whether fresh or corrupting; and when there is a deficiency of that, bread, or any other provision, will suffice. It is very dangerous approaching them if not quite tame; and they sometimes send forth a loud piercing lamentable cry, which renders them still more formidable. The eagle drinks but seldom; and perhaps when at liberty not at all, as the blood of its prey serves to quench its thirst. The eagle's excrements are always soft and moist, and tinged with that whitish substance which, as was said before, mixes in birds with the urine.

Such are the general characteristics and habitudes of the eagle; but in some they differ, as the sea eagle and the osprey live chiefly upon fish, and consequently build their nests on the sea-shore, and by the sides of rivers on the ground among reeds; and often lay three or four eggs, rather less than those of a hen, of a white elliptical form. They catch their prey, which is chiefly fish, by darting down upon them from above. The Italians compare the violent descent of these birds on their prey to the fall of lead into water; and call them *aquila piombina*, or the leaden eagle.

Nor is the bald eagle, which is an inhabitant of North Carolina, less remarkable for habits peculiar to itself. These birds breed in that country all the year round. When the eaglets are just covered with down and a sort of white woolly feathers, the female eagle lays again. These eggs are left to be hatched by the warmth of the young ones that continue in the nest; so that the flight of one brood makes room for the next that are but just hatched. These birds fly heavily; so that they cannot overtake their prey, like others of the same denomination. To remedy this, they often attend a sort of fishing-hawk, which they pursue, and strip the plunderer of its prey. This is the more remarkable as this hawk flies swifter than they. These eagles also generally attend upon fowlers in the winter, and when any birds are wounded, they are sure to be seized by the eagle, though they may fly from the fowler. This bird will often also steal young pigs, and carry them alive to the nest, which is composed of twigs, sticks, and rubbish; it is large enough to fill the body of a cart; and is commonly full of bones half eaten, and putrid flesh, the stench of which is intolerable.

The distinctive marks of each species are as follow:

The *golden eagle:* of a tawny, iron colour; the head and neck of a reddish iron; the tail feathers of a dirty white, marked with cross bands of tawny iron; the legs covered with tawny iron feathers.

The *common eagle:* of a brown colour; the head and upper part of the neck inclining to red; the tail feathers white, blackening at the ends; the outer ones on each side of an ash colour; the legs covered with feathers of a reddish brown.

The *bald eagle*: brown; the head, neck, and tail feathers white; the feathers of the upper part of the leg brown.

The *white eagle:* the whole white.

The *kough-footed eagle:* of a dirty brown; spotted under the wings, and on the legs, with white; the feathers of the tail white at the beginning and the point; the leg feathers dirty brown, spotted with white.

The *white tailed eagle:* dirty brown; head white; the stems of the feathers black; the rump inclining to black; the tail feathers, the first half black, the end half white; legs naked.

The *erne:* a dirty iron colour above, an iron mixed with black below; the head and neck ash, mixed with chesnut; the points of the wings blackish; the tail feathers white; the legs naked.

The *black eagle:* blackish, the head and upper neck mixed with red; the tail feathers, the first half white, speckled with black; the other half blackish; the leg feathers dirty white.

The *sea eagle:* inclining to white, mixed with iron brown; belly white, with iron-coloured spots; the covert feathers of the tail whitish; the tail feathers black at the extremity; the upper part of the leg feathers of an iron brown.

The *osprey:* brown above; white below; the back of the head white, the outward tail feathers, on the inner side, streaked with white; legs naked.

The *jean le blanc:* above, brownish grey; below, white, spotted with tawny brown; the tail feathers, on the outside and at the extremity, brown; on the inside, white, streaked with brown; legs naked.

The *eagle of Brasil:* blackish brown; ash colour, mixed in the wings; tail feathers white; legs naked.

The *Oroonoko eagle:* with a topping above, blackish brown; below, white, spotted with black, upper neck yellow; tail feathers brown, with white circles; leg feathers white, spotted with black.

The *crowned African eagle:* with a topping; the tail of an ash colour, streaked on the upper side with black.

The *eagle of Pondicherry:* chesnut colour; the six outward tail feathers black one half.

THE CONDOR OF AMERICA.

We might now speak of the vulture kind, as they hold the next rank to the eagle; but we are interrupted, by the consideration of an enormous bird, whose place is not yet ascertained; as naturalists are in doubt whether to refer it to the eagle tribe, or to that of the vulture. Its great strength, force, and vivacity, might plead for its place among the former; the baldness of its head and neck might be thought to degrade it among the latter. In this uncertainty it will be enough to describe the bird by the lights we have, and leave future historians to settle its rank in the feathered creation. Indeed, if size and strength, combined with rapidity of flight and rapacity, deserve pre-eminence, no bird can compare with it.

The condor possesses, in an higher degree than the eagle, all the qualities that render it formidable, not only to the feathered kind, but to beasts, and even to man himself.—Acosta, Garcilasso, and Desmarchais, assert, that it is eighteen feet across, the wings extended. The beak is so strong as to pierce the body of a cow; and two of them are able to devour it. They do not even abstain from man himself: but fortunately there are but few of the species; for if they had been plenty, every order of animals must have carried on an unsuccessful war against them. The Indians assert, that they will carry off a deer, or a young calf, in their talons, as eagles would a hare or a rabbit; that their sight is piercing, and their air terrible; that they seldom frequent the forests, as they require a large space for the display of their wings; but that they are found on the sea-shore, and the banks of rivers, whither they descend from the heights of the mountains. By later accounts we learn, that they come down to the sea-shore only at certain seasons, when their prey happens to fail them upon land; that they then feed upon dead fish, and such other nutricious substances as the sea throws upon the shore. We are assured that their countenance is not so terrible as old writers have represented it; but that they appear milder than either the eagle or the vulture.

Condamine has frequently seen them in several parts of the mountains of Quito, and observed them hovering over a flock of sheep; and he thinks they would, at a certain time, have attempted to carry one off, had they not been scared away by the shepherds. Labat says, that those who have seen this animal, declare that the body is as large as that of a sheep; and that the flesh is tough, and as disagreeable as carrion. The Spaniards themselves seem to dread its depredations; and there have been instances of its carrying off their children.

Mr. Strong, the master of a ship, as he was sailing along the coasts of Chili, in the thirty-third degree of south latitude, observed a bird sitting upon a high cliff near the shore, which some of the ship's company shot with a leaden bullet and killed. They were greatly surprised when they beheld its magnitude; for when the wings were extended, they measured thirteen feet from one tip to the other. One of the quills was two feet four inches long: and the barrel, or hollow part, was six inches and three quarters, and an inch and a half in circumference.

We have a still more circumstantial account of this amazing bird, by P. Feuillée, the only traveller who has accurately described it: "In the valley of Illo in Peru, I discovered a condor perched on a high rock before me: I approached within gun-shot and fired; but, as my piece was only charged with swan-shot, the lead was not able sufficiently to pierce the bird's feathers. I perceived, however, by its manner of flying, that it was wounded; and it was with a good deal of difficulty that it flew to another rock, about five hundred yards distant on the sea-shore. I therefore charged again with ball, and hit the bird under the throat, which made it mine. I accordingly ran up to seize it; but even in death it was terrible, and defended itself upon its back, with its claws extended against me, so that I scarce knew how to lay hold of it. Had it not been mortally wounded, I should have found it no easy matter to take it; but I at last dragged it down from the rock, and with the assistance of one of the seamen, I carried it to my tent, to make a coloured drawing.

'The wings of this bird, which I measured very exactly, were twelve feet three inches (English) from tip to tip. The great feathers, that were of a beautiful shining black, were two feet four inches long. The thickness of the beak was proportionable to the rest of the body; the length about four inches; the point hooked downwards, and white at its extremity; and the other part was of a jet black. A short down, of a brown colour, covered the head; the eyes were black, and surrounded with a circle of reddish brown. The feathers on the breast, neck, and wings, were of a light brown; those on the back were rather darker. Its thighs were covered with brown feathers to the knee. The thigh bone was ten inches long; the leg five inches; the toes were three before and one behind; that behind was an inch and a half; and the claw with which it was armed was black, and three quarters of an inch. The other claws were in the same proportion; and the leg was covered with black scales, as also the toes; but in these the scales were larger.

'These birds usually keep in the mountains where they find their prey: they never descend to the sea-shore but in the rainy season; for, as they are very sensible of cold, they go there for greater warmth. Though these mountains are situated in the torrid zone, the cold is often very severe; for a great part of the year they are covered with snow, but particularly in winter.

'The little nourishment which these birds find on the sea-coast, except when the tempest drives in some great fish, obliges the condor to continue there but a short time. They usually come to the coast at the approach of evening; stay there all night, and fly back in the morning.'

It is doubted whether this animal be proper to America only, or whether it may not have been described by the naturalists of other countries. It is supposed that the great bird called the Rock, described by Arabian writers, and so much exaggerated by fable, is but a species of the condor.—The great bird of Tarnassar, in the East Indies, that is larger than the eagle, as well as the vulture of Senegal, that carries off children, are probably no other than the bird we have been describing. Russia, Lapland, and even Switzerland and Germany are said to have known this animal. A bird of this kind was shot in France, that weighed eighteen pounds, and was said to be eighteen feet across the wings; however, one of the quills was described only as being larger than that of a swan; so that probably the breadth of the wings may have been exaggerated, since a bird so large would have the quills more than twice as big as those of a swan. However this be, we are not to regret that it is scarcely ever seen in Europe, as it appears to be one of the most formidable enemies of mankind. In the deserts of Pachomac, where it is chiefly seen, men seldom venture to travel. Those wild regions are very sufficient of themselves to inspire a secret horror: broken precipices—prowling panthers—forests only vocal with the hissing of serpents—and mountains rendered still more terrible by the condor, the only bird that ventures to make its residence in those deserted situations.

OF THE VULTURE AND ITS AFFINITIES.

The first rank in the description of birds, has been given to the eagle; not because it is stronger and larger than the vulture, but because it is more generous and bold. The eagle, unless pressed by famine, will not stoop to carrion; and never devours but what he has earned by his own pursuit. The vulture, on the contrary, is indelicately voracious; and seldom attacks living animals, when it can be supplied with dead. The eagle meets, and singly opposes his enemy; the vulture, if he expects resistance, calls in the aid of its kind, and overpowers its prey by a cowardly combination. Putrefaction and stench, instead of deterring, only allure them. The vulture seems among birds, what the jackal and hyæna are among quadrupeds, who prey upon carcasses, and root up the dead.

Vultures may be distinguished from all those of the eagle kind, by the nakedness of their heads and necks, which are without feathers, and only covered with a very slight down, or a few scattered hairs. Their eyes are more prominent; those of the eagle's being buried more in the socket. Their claws are shorter, and less hooked. The inside of the wing is covered with a thick down, which is different in them from all other birds of prey. Their attitude is not so upright as that of the eagle; and their flight more difficult and heavy.

In this tribe we may range the golden, the ash-coloured, and the brown vulture, which are inhabitants of Europe; the spotted and the black vulture of Egypt; the bearded vulture; the Brasilian vulture, and the king of the vultures of South America. They all agree in their nature; being equally indolent, yet rapacious and unclean.

The Golden Vulture seems to be the foremost of the kind; and is in many respects like the golden eagle, but larger in every proportion. From the end of the beak to that of the tail, it is four feet and a half; and to the claws' end, forty-five inches. The length of the upper mandible is almost seven inches; and the tail twenty-seven inches long. The lower part of the neck, breast, and belly, are of a red colour; but on the tail it is more faint, and deeper near the head. The feathers are black on the back; and on the wings and tail of a yellowish brown. Others of the kind differ from this colour and dimensions; but they are all marked by their naked heads, and beak straight in the beginning but hooking at the point.

They are still more strongly marked by their nature, which, as has been observed, is cruel, unclean, and indolent. Their sense of smelling is amazingly great; Nature having given them two large apertures or nostrils without, and an olfactory membrane within. Their intestines are formed differently from those of the eagle kind; for they partake more of the formation of such birds as live upon grain. They have both a crop and a stomach; which may be regarded as a kind of gizzard, from the thickness of the muscles of which it is composed. In fact, they seem adapted inwardly, not only for being carnivorous, but to eat corn, or whatever of that kind comes in their way.

This bird, which is common in many parts of Europe, and but too well known on the western continent, is totally unknown in England. In Egypt, Arabia, and many other kingdoms of Africa and Asia, vultures are found in great abundance. The inside down of their wing is converted into a very warm and comfortable kind of fur, and is commonly sold in the Asiatic markets.

In Egypt, this bird seems to be of singular service. There are great flocks of them in the neighbourhood of Grand Cairo, which no person is permitted to destroy. The service they render the inhabitants, is the devouring all the carrion and filth of that great city; which might otherwise tend to corrupt and putrefy the air. They are commonly seen in company with the wild dogs of the country, tearing a carcase deliberately together. This odd association produces no quarrels; the birds and quadrupeds seem to live amicably, and nothing but harmony subsists between them. The wonder is still the greater, as both are extremely rapacious, and both lean and bony to a great degree; probably having no great plenty even of the wretched food on which they subsist.

In America they lead a life somewhat similar. Wherever the hunters, who there only pursue beasts for the skins, are found to go, these birds are seen to pursue them. They still keep hovering at a little distance; and when they see the beast flayed and abandoned, they call out to each other, pour down upon the carcase, and, in an instant, pick its bones as bare and clean as if they had been scraped by a knife.

At the Cape of Good Hope, in Africa, they seem to discover a still greater share of dexterity in their methods of carving. 'I have,' says Kolben, 'been often a spectator of the manner in which they have anatomized a dead body; I say anatomized; for no artist in the world could have done it more cleanly. They have a wonderful method of separating the flesh from the bones, and yet leaving the skin quite entire. Upon coming near the carcase, one would not suppose it thus deprived of its internal substance, till he began to examine it more closely; he then finds it, literally speaking, nothing but skin and bone. Their manner of performing the operation is this: they first make an opening in the belly of the animal, from whence they pluck out and greedily devour the entrails: then entering into the hollow which they have made, they separate the flesh from the bones, without ever touching the skin. It often happens that an ox returning home alone to its stall from the plough, lies down by the way: it is then, if the vultures perceive it, that they fall with fury down, and inevitably devour the unfortunate animal. They sometimes attempt them grazing in the fields; and then, to the number of a hundred or more, make their attack all at once and together.'

'They are attracted by carrion,' says Catesby, 'from a very great distance. It is pleasant to behold them, when they are thus eating, and disputing for their prey. An eagle generally presides at these entertainments, and makes them all keep their distance till he has done. They then fall to with an excellent appetite; and their sense of smelling is so exquisite, that the instant a carcase drops, we may see the vultures floating in the air from all quarters, and come sousing on their prey.' It is supposed by some, that they eat nothing that has life; but this is only when they are not able: for when they can come at lambs they show no mercy; and serpents are their ordinary food. The manner of those birds is to perch themselves, several together, on the old pine and cypress trees; where they continue all the morning, for several hours, with their wings unfolded: nor are they fearful of danger, but suffer people to approach them very near, even when they are eating.

The sloth, the filth, and the voraciousness of these birds, almost exceed credibility. In the Brasils, where they are found in great abundance, when they light upon a carcase, which they have liberty to tear at their ease, they so gorge themselves that they are unable to fly; but keep hopping along when they are pursued. At all times they are a bird of slow flight, and unable readily to raise themselves from the ground; but when they have overfed, they are then utterly helpless; but they soon get rid of their burden; for they have a method of vomiting up what they have eaten, and then they fly off with greater facility.

It is pleasant, however, to be a spectator of the hostilities between animals that are thus hateful or noxious. Of all creatures the two most at enmity are, the vulture of Brasil and the crocodile. The female of this terrible amphibious creature, which in the rivers of that part of the world grows to the size of twenty-seven feet, lays its eggs, to the number of one or two hundred, in the sands, on the side of the river, where they are hatched by the heat of the climate. For this purpose she takes every precaution to hide from all other animals the place where she deposits her burden: in the mean time a number of vultures sit silent and unseen, in the branches of some neighbouring forest, and view the crocodile's operations, with the expectation of succeeding plunder. They patiently wait till the crocodile has laid the whole number of her eggs, till she has covered them carefully under the sand, and until she is retired from them to a convenient distance. Then, all together, encouraging each other with cries, they pour down upon the nest, hook up the sand in a moment, lay the eggs bare, and devour the whole brood. Wretched as is the flesh of these animals, yet men, perhaps when pressed by hunger, have been tempted to taste it. Nothing can be more lean, stringy, nauseous, and unsavoury. It is in vain that when killed the rump has been cut off; in vain the body has been washed, and spices used to overpower its prevailing odour; it still smells and tastes of the carrion by which it was nourished, and sends forth a stench that is insupportable.

These birds, at least those of Europe, usually lay two eggs at a time, and produce but once a year. They make their nests in inaccessible cliffs, and places so remote, that it is rare to find them. Those in our part of the world chiefly reside in the places where they breed, and seldom come into the plains, except when snow and ice in their retreats have banished all living animals but themselves: they then descend, and brave the perils they must encounter in a more cultivated region. As carrion is not found at those seasons in sufficient quantity, or sufficiently remote from man, to sustain them, they prey upon rabbits, hares, serpents, and whatever small game they can overpower.

Such are the manners of this bird in general; but there is one of the kind, called the king of the vultures, which, from its extraordinary figure, deserves a separate description. This bird is a native of America, and not of the East Indies, as those who make a trade of showing birds would induce us to believe. It is larger than a turkey-cock; but chiefly remarkable for the odd formation of the skin of the head and neck, which is bare. This skin arises from the base of the bill, and is of an orange colour; from whence it stretches on each side of the head; from thence it proceeds, like an indented comb, and falls on either side, according to the motion of the head. The eyes are surrounded by a skin, of a scarlet colour; and the iris has the colour and lustre of pearl. The head and neck are without feathers, covered with a flesh-coloured skin on the upper part, a fine scarlet behind the head, and a duskier skin before; farther down, behind the head, arises a little tuft of black down, from whence issues and extends beneath the throat, on each side, a wrinkled skin, of a brownish hue, mixed with blue, and reddish behind: below, upon the naked part of the neck, is a collar formed by soft, longish feathers, of a deep ash-colour, which surround the neck, and cover the breast before. Into this collar the bird sometimes withdraws its whole neck, and sometimes a part of its head; so that it looks as if it had withdrawn the neck into the body. Those marks are sufficient to distinguish this bird from all others of the vulture kind; and it cannot be doubted, but that it is the most beautiful of all this deformed family; yet neither its habits nor instinct vary from the rest of the tribe, being like them a slow cowardly bird, living chiefly upon rats, lizards, and serpents; and upon carrion, when it happens to be in the way. The flesh is so bad that even savages cannot bear with it.

OF THE FALCON KIND AND ITS AFFINITIES.

Every creature becomes more important in the history of nature in proportion as it is connected with man. In this view the smallest vegetable, or the most seemingly contemptible insect, is a subject more deserving attention than the most flourishing tree, or the most beautiful of the feathered creation. The falcon is indeed a more important animal than the eagle or the vulture; and though so diminutive in the comparison, is, from its connection with our pleasures, a more interesting object of curiosity.

The amusement of hawking is now pretty much given over in this kingdom; for as every country refines, as its inclosures become higher and closer, those rural sports consequently decline, in which the game is to be pursued over a long extent of country; and where, while every thing retards the pursuer below, nothing can stop the object of his pursuit above.

Falconry, that is now so much disused among us, was the principal amusement of our ancestors. A person of rank scarcely stirred out without his hawk on his hand; which in old paintings is the criterion of nobility. Harold, afterwards king of England, when he went on a most important embassy into Normandy, is drawn in an old bas-relief, as embarking with a bird on his fist, and a dog under his arm. In those days it was thought sufficient for noblemen's sons to wind the horn and to carry their hawk fair, and leave study and learning to the children of meaner people. Indeed this diversion was in such high esteem among the great all over Europe, that Frederick, one of the emperors of Germany, thought it not beneath him to write a treatise upon hawking.

The expense which attended this sport was great: among the old Welch princes the king's falconer was the fourth officer in the state; but notwithstanding all his honours he was forbid to take more than three draughts of beer from his horn, lest he should get drunk and neglect his duty. In the reign of James I. Sir Thomas Monson is said to have given a thousand pounds for a cast of hawks; and such was their value in general, that it was made felony in the reign of Edward III. to steal a hawk. To take its eggs, even in a person's own ground, was punishable with imprisonment for a year and a day, together with a fine at the king's pleasure. In the reign of Elizabeth the imprisonment was reduced to three months; but the offender was to lie in prison till he got security for his good behaviour for seven years farther. In the earlier times the art of gunning was but little practised, and the hawk was then valuable, not only for its affording diversion, but for its procuring delicacies for the table, that could seldom be obtained any other way.

Of many of the ancient falcons used for this purpose, we at this time know only the names, as the exact species are so ill described, that one may be very easily mistaken for another. Of those in use at present, both here and in other countries, are the gyr-falcon, the falcon, the lanner, the sacre, the hobby, the kestril, and the merlin. These are called the long-winged hawks, to distinguish them from the goss-hawk, the sparrow-hawk, the kite, and the bustard, that are of a shorter wing, and either too slow, too cowardly, too indolent, or too obstinate, to be serviceable in contributing to the pleasures of the field.

The generous tribe of hawks, as was said, are distinguished from the rest by the length of their wings, which reach nearly as low as the tail. In these the first quill of the wing is nearly as long as the second; it terminates in a point which begins to diminish from about an inch of its extremity. This distinguishes the generous breed from that of the baser race of kites, sparrow-hawks, and buzzards, in whom the tail is longer than the wings, and the first feather of the wing is rounded at the extremity. They differ also in the latter having the fourth feather of the wing longest; in the generous race it is always the second.

The generous race, which have been taken into the service of man, are endowed with natural powers that the other kinds are not possessed of. From the length of their wings, they are swifter to pursue their game; from a confidence in this swiftness they are bolder to attack it; and they have an attachment to their feeder, and consequently a docility, which the baser birds are strangers to.

The gyr-falcon leads in this bold train. He exceeds all other falcons in the largeness of his size, for he approaches nearly to the magnitude of the eagle. The top of the head is flat, and of an ash-colour, with a strong, thick, short, and blue beak. The feathers of the back and wings are marked with blue spots, in the shape of a heart; he is a courageous and fierce bird, nor fears even the eagle himself; but he chiefly flies at the stork, the heron, and the crane. He is mostly found in the colder regions of the north, but loses neither his strength nor his courage when brought into the milder climates.

The falcon, properly so called, is the second in magnitude and fame. There are some varieties in this bird; but there seem to be only two that claim distinction; falcon-gentil and the peregrine-falcon; both are much less than the gyr, and somewhat about the size of a raven. They differ but slightly, and perhaps only from the different states they were in when brought into captivity. The falcon-gentil moults in March, and often sooner: the peregrine-falcon does not moult till the middle of August. The peregrine is stronger in the shoulder, has a larger eye, and yet more sunk in the head; his beak is stronger, his legs longer, and the toes better divided.

Next in size to these is the lanner, a bird now little known in Europe; then follows the sacre, the legs of which are bluish, and serve to distinguish that bird; to them succeeds the hobby, used for smaller game, for daring larks, and stooping at quails. The kestril was trained for the same purposes; and, lastly, the merlin; which though the smallest of the hawk or falcon kind, and not much larger than a thrush, yet displays a degree of courage that renders him formidable even to birds ten times the size. He has been known to kill a partridge or a quail, at a single pounce from above.

Some of the other species of sluggish birds were sometimes trained to this sport, but it was when no better could be obtained; and those just described were considered as birds of nobler races. Their courage in general was such, that no bird, not very much above their own size, could terrify them; their swiftness so great, that scarcely any bird could escape them; and their docility so remarkable, that they obeyed not only the commands but the signs of their master. They remained quietly perched upon his hand till their game was flushed, or else kept hovering round his head, without leaving him but when he gave permission. The common falcon is a bird of such spirit, that, like a conqueror in a country, he keeps all birds in awe and in subjection to his prowess. When he is seen flying wild, as I have often had an opportunity of observing, the birds of every kind, that seemed entirely to disregard the kite or the sparrow-hawk, fly with screams at his most distant appearance. Long before I could see the falcon, I have observed them with signs of terror endeavouring to avoid him: and, like peasants of a country before a victorious army, every one attempting to shift for himself. Even the young falcons, though their spirits be depressed by captivity, will, when brought into the field, venture to fly at barnacles and wild geese, till, being soundly brushed and beaten by those strong birds, they learn their error, and desist from meddling with such unwieldy game for the future.

To train up the hawk to this kind of obedience, so as to hunt for his master, and bring him the game he shall kill, requires no small degree of skill and assiduity. Numberless treatises have been written upon this subject, which are now, with the sport itself, almost entirely forgotten: indeed, except to a few, they seem utterly unintelligible; for the falconers had a language peculiar to themselves, in which they conversed and wrote, and took a kind of professional pride in using no other. A modern reader, I suppose, would be little edified by one of the instructions, for instance, which we find in Willoughby, when he bids us *draw our falcon out of the mew twenty days before we enseam her. If she truss and carry, the remedy is, cosse her talons, her powse, and petty single.*

In order to train up a falcon, the master begins by clapping straps upon his legs, which are called *jesses*, to which there is fastened a ring with the owner's name, by which, in case he should be lost, the finder may know where to bring him back. To these also are added little bells, which serve to mark the place where he is, if lost in the chase. He is always carried on the fist, and obliged to keep without sleeping. If he be stubborn, and attempt to bite, his head is plunged into water. Thus, by hunger, watching, and fatigue, he is constrained to submit to having his head covered by a hood or cowl, which hides his eyes. This troublesome employment continues often for three days and nights without ceasing. It rarely happens but at the end of this his necessities, and the privation of light, make him lose all idea of liberty, and soften his natural wildness. His master judges of his being tamed when he permits his head to be covered without resistance, and when uncovered he seizes the meat before him contentedly. The repetition of these lessons by degrees ensures success. His wants being the chief principle of his dependence, it is endeavoured to increase his appetite by giving him little balls of flannel, which he greedily swallows. Having thus excited the appetite, care is taken to satisfy it; and thus gratitude attaches the bird to him who but just before had been his tormentor.

When the first lessons have succeeded, and the bird shows signs of docility, he is carried out upon some green, the head is uncovered, and, by flattering him with food at different times, he is taught to jump on the fist, and to continue there. When confirmed in this habit, it is then thought time to make him acquainted with the lure. This lure is only a thing stuffed like the bird the falcon is designed to pursue, such as a heron, a pigeon, or a quail, and on this lure they always take care to give him his food. It is quite necessary that the bird should not only be acquainted with this but fond of it, and delicate in his food when shown it. When the falcon has flown upon this, and tasted the first morsel, some falconers then take it away; but by this there is a danger of daunting the bird; and the surest method is, when he flies to seize it, to let him feed at large, and this recompenses his docility. The use of this lure is to flatter him back when he has flown in the air, which it sometimes fails to do; and it is always requisite to assist it by the voice and the signs of the master. When these lessons have been long repeated, it is necessary to study the character of the bird; to speak frequently to him if he be inattentive to the voice; to stint in his food such as do not come readily to the lure; to keep waking him if he be not sufficiently familiar; and to cover him frequently with the hood if he fears darkness. When the familiarity and the docility of the bird are sufficiently confirmed on the green, he is then carried into the open fields, but still kept fast by a string which is about twenty yards long. He is then uncovered as before; and the falconer, calling him at some paces distance, shows him the lure. When he flies upon it he is permitted to take a large piece of the food which is tied to it. Next day the lure is shown him at a greater distance, till he comes at last to fly to it at the utmost length of his string. He is then to be shown the game itself alive, but disabled or tame, which he is designed to pursue. After having seized this several times with his string, he is then left at liberty, and carried into the field for the purposes of pursuing that which is wild. At that he flies with avidity; and when he has seized it or killed it, he is brought back by the voice and the lure.

By this method of instruction, an hawk may be taught to fly at any game whatsoever; but falconers have chiefly confined their pursuit only to such animals as yield them profit by capture or pleasure in the pursuit. The hare, the partridge, and the quail, repay the trouble of taking them; but the most delightful sport is the falcon's pursuit of the heron, the kite, or the wood-lark. Instead of flying directly forward when they see themselves threatened by the approach of the hawk, they immediately take to the skies. They fly almost perpendicularly upward, while their pursuer keeps pace with their flight, and tries to rise above them. Thus both diminish by degrees from the gazing spectator below, till they are quite lost in the clouds; but they are soon seen descending, struggling together, and using every effort on both sides; the one of rapacious insult, the other of desperate defence. The unequal combat is soon at an end; the falcon comes off victorious, and the other killed, or disabled, is made a prey either to the bird or the sportsman.

As for other birds, they are not so much pursued, as they generally fly straight forward, by which the sportsman loses sight of the chase, and runs a chance of losing his falcon also. The pursuit of the lark by a couple of merlins is considered, to him only who regards the sagacity of the chase, as one of the most delightful spectacles this exercise can afford. The amusement is to see one of the merlins climbing to get the ascendant of the lark, while the other, lying low for the best advantage, waits the success of its companion's efforts; thus while the one stoops to strike its prey, the other seizes it at its coming down.

Such is the natural and acquired habits of these birds, which of all others have the greatest strength and courage relative to their size. While the kite or the goss-hawk approach their prey side-ways, these dart perpendicularly, in their wild state, upon their game, and devour it on the spot, or carry it off, if not too large for their power of flying. They are sometimes seen descending perpendicularly from the clouds, from an amazing height, and darting down on their prey with inevitable swiftness and destruction.

The more ignoble race of birds make up by cunning and assiduity what these claim by force and celerity. Being less courageous, they are more patient; and, having less swiftness, they are better skilled at taking their prey by surprise. The kite, that may be distinguished from all the rest of this tribe by his forky tail and slow floating motion, seems almost for ever upon the wing. He appears to rest upon the bosom of the air, and not to make the smallest effort in flying. He lives only upon accidental carnage, for almost every bird in the air is able to make good his retreat against him. He may be therefore considered as an insidious thief who only prowls about, and, when he finds a small bird wounded, or a young chicken strayed too far from the mother, instantly seizes the hour of calamity, and, like a famished glutton, is sure to show no mercy. His hunger, indeed, often urges him to acts of seeming desperation. I have seen one of them fly round and round for a while to mark a clutch of chickens, and then on a sudden dart like lightning upon the unresisting little animal, and carry it off, the hen in vain crying out, and the boys hooting and casting stones to scare it from its plunder. For this reason, of all birds, the kite is the good housewife's greatest tormentor and aversion.

Of all obscure birds, the kite is the best known; but the buzzard, among us is the most plenty. He is a sluggish inactive bird, and often remains perched whole days together upon the same bough. He is rather an assassin than a pursuer; and lives more upon frogs, mice, and insects, which he can easily seize, than upon birds which he is obliged to follow. He lives in summer by robbing the nests of other birds, and sucking their eggs, and more resembles the owl kind in his countenance than any other rapacious bird of day. His figure implies the stupidity of his disposition; and so little is he capable of instruction from man, that it is common to a proverb to call one who cannot be taught, or continues obstinately ignorant, a *buzzard.* The honey-buzzard, the moor-buzzard, and the hen harrier, are all of this stupid tribe, and differ chiefly in their size, growing less in the order I have named. The goss-hawk and sparrow-hawk are what Mr. Willoughby calls short-winged birds, and unfit for training, however injurious they may be to the pigeon-house. They have been taught to fly at game; but little is to be obtained from their efforts, being difficult of instruction and capricious in obedience. It has been lately asserted by respectable authority, that the sparrow-hawk is the boldest and best of all others for the pleasure of the chase.

THE BUTCHER BIRD.

Before I conclude this short history of rapacious birds that prey by day, I must take leave to describe a tribe of smaller birds, that seem from their size rather to be classed with the harmless order of the sparrow kind; but that from their crooked beak, courage, and appetites for slaughter, certainly deserve a place here. The lesser butcher-bird is not much above the size of a lark; that of the smallest species is not so big as a sparrow; yet diminutive as these little animals are, they make themselves formidable to birds of four times their dimensions.

The greater butcher-bird is about as large as a thrush; its bill is black, an inch long, and hooked at the end. This mark, together with its carnivorous appetite, ranks it among the rapacious birds; at the same time that its legs and feet, which are slender, and its toes, formed somewhat differently from the former, would seem to make it the shade between such birds as live wholly upon flesh, and such as live chiefly upon insects and grain.

Indeed its habits seem to correspond with its conformation, as it is found to live as well upon flesh as insects, and thus to partake in some measure of a double nature. But its appetite for flesh is most prevalent; and it never takes up with the former when it can obtain the latter. This bird, therefore, leads a life of combat and opposition. As from its size it does not much terrify the smaller birds of the forest, so it frequently meets with birds willing to try its strength, and it never declines the engagement.

It is wonderful to see with what intrepidity this little creature goes to war with the pie, the crow, and the kestril, all above four times bigger than itself, and that sometimes prey upon flesh in the same manner. It not only fights upon the defensive, but often comes to the attack, and always with advantage, particularly when the male and female unite to protect their young, and to drive away the more powerful birds of rapine. At that season they do not wait the approach of their invader; it is sufficient that they see him preparing for the assault at a distance. It is then that they sally forth with loud cries, wound him on every side, and drive him off with such fury, that he seldom ventures to return to the charge. In these kinds of disputes they generally come off with the victory; though it somtimes happens that they fall to the ground with the bird they have so fiercely fixed upon, and the combat ends with the destruction of the assailant as well as the defender.

Small birds are its usual food. It seizes them by the throat, and strangles them in an instant. When it has thus killed the bird or insect, it is asserted by the best authority, that it fixes them upon some neighbouring thorn, and when thus spitted pulls them to pieces with its bill.

During summer, such of them as constantly reside here, for the smaller red butcher-bird migrates, remain among the mountainous parts of the country; but in winter they descend into the plains, and nearer human habitations. The larger kind make their nest on the highest trees, while the lesser build in bushes in the fields and hedge-rows. They both lay about six eggs of a white colour, but encircled at the bigger end with a ring of brownish red. The nest on the outside is composed of white moss, interwoven with long grass; within it is well lined with wool, and is usually fixed among the forking branches of a tree. The female feeds her young with caterpillars and other insects while very young; but soon after accustoms them to flesh, which the male procures with surprising industry. Their nature also is different from other birds of prey in their parental attention; for so far from driving out their young to shift for themselves, they keep them with care, and even when grown they do not forsake them, but the whole brood live in one family together. Upon the returning season of courtship this union is at an end, the family parts for ever, each to establish a little household of its own. It is easy to distinguish these birds at a distance, not only from their going in companies, but also from their manner of flying, which is always up and down, seldom direct or sideways.

Of these birds there are three or four different kinds; but the greater ash-coloured butcher-bird is the least known among us. The red-backed butcher-bird migrates in autumn, and does not return till spring. The woodchat resembles the former, except in the colour of its back, which is brown, and not red as in the other. There is still another, less than either of the former, found in the marshes near London. This too is a bird of prey, although not much bigger than a titmouse; an evident proof that an animal's courage or rapacity does not depend upon its size.

OF RAPACIOUS BIRDS OF THE OWL KIND THAT PREY BY NIGHT.

We have hitherto been describing a tribe of animals who, though plunderers among their fellows of the air, yet wage war boldly in the face of day. We now come to a race equally cruel and rapacious; but who add to their savage disposition the further reproach of treachery, and carry on all their depredations by night.

All birds of the owl kind may be considered as nocturnal robbers, who, unfitted for taking their prey while it is light, surprise it at those hours of rest when the tribes of nature are in no expectation of an enemy. Thus there seems no link in nature's chain broken; no where a dead inactive repose; but every place, every season, every hour of the day and night is bustling with life, and furnishing instances of industry, self-defence, and invasion.

All birds of the owl kind have one common mark, by which they are distinguished from others; their eyes are formed for seeing better in the dusk than in the broad glare of sun-shine. As there is a quality in the retina that takes in the rays of light so copiously as to permit of tigers and cats seeing in places almost dark; so in these birds there is the same conformation of that organ, and though, like us, they cannot see in a total exclusion of light, yet they are sufficiently quick-sighted at times when we remain in total obscurity. In the eyes of all animals nature hath made a provision, either to shut out too much light, or to admit a sufficiency, by the contraction and dilatation of the pupil. In these birds the pupil is capable of opening very wide, or shutting very close: by contracting the pupil the brighter light of the day, which would act too powerfully upon the sensibility of the retina, is excluded; by dilating the pupil the animal takes in the more faint rays of the night, and thereby is enabled to see its prey, and catch it with greater facility in the dark. Beside this, there is an irradiation on the back of the eye, and the iris itself has a faculty of reflecting the rays of light, so as to assist vision in the gloomy places where these birds are found to be frequent.

Though owls are dazzled by too bright a day-light, they do not see best in the darkest nights, as some have imagined. It is in the dusk of the evening, or the grey of the morning, that they are best fitted for seeing, at those seasons when there is neither too much light, nor too little. Then they leave their retreats to hunt or surprise their prey, which is usually attended with success: it is then that they find all other birds asleep, or preparing for repose, and they have only to seize the most unguarded.

The nights when the moon shines are the times of their most successful plunder; for when it is wholly dark they are less qualified for seeing and pursuing their prey; except by moonlight, they contract the hours of their chace: and if they come out at the approach of dusk in the evening, they return before it is totally dark, and then rise by twilight the next morning to pursue their game, and return in like manner, before the broad day-light begins to dazzle them with its splendour.

Yet the faculty of seeing in the night, or of being entirely dazzled by day, is not alike in every species of these nocturnal birds: some see by night better than others; and some are so little dazzled by day-light, that they perceive their enemies and avoid them. The common white or barn owl, for instance, sees with such exquisite acuteness in the dark, that though the barn has been shut at night, and the light thus totally excluded, yet it perceives the smallest mouse that peeps from its hole: on the contrary the brown horn owl is often seen to prowl along the hedges by day, like the sparrow-hawk; and sometimes with good success.

All birds of the owl kind may be divided into two sorts; those that have horns, and those without. These horns are nothing more than two or three feathers that stand upon each side of the head over the ear, and give this animal a kind of horned appearance. Of the horned kind is, the great horned owl, which at first view appears as large as an eagle. But when observed more closely, he will appear much less. His legs, body, wings, and tail, are shorter; his head much larger and thicker; his horns are composed of feathers that rise above two inches and a half high, and which he can erect or depress at pleasure: his eyes are large and transparent, encircled with an orange-coloured iris; his ears are large and deep, and it would appear that no animal was possessed with a more exquisite sense of hearing; his plumage is of a reddish brown, marked on the back with black and yellow spots, and yellow only upon the belly.

Next to this is the common horned owl, of a smaller size than the former, and with shorter horns. As the great owl was five feet from the tip of one wing to the other, this is but three. The horns are but about an inch long, and consist of six feathers, variegated with black and yellow.

There is a still a smaller kind of the horned owl, which is not much larger than a blackbird; and whose horns are remarkably short, being composed of but one feather, and that not above half an inch high.

To these succeeds the tribe without horns. The howlet, which is the largest of this kind, with dusky plumes and black eyes; the screech owl, of a smaller size, with blue eyes, and a plumage of an iron grey; the white owl, about as large as the former, with yellow eyes and whitish plumage; the great brown owl, less than the former, with brown plumage and a brown beak; and, lastly, the little brown owl, with yellowish coloured eyes, and an orange-coloured bill. The foreign denominations differ but little from our own, if we except the harfang, or great Hudson's Bay owl of Edwards, which is the largest of all the nocturnal tribe, and as white as the snows of his native country.

All this tribe of animals, however they may differ in their size and plumage, agree in their characteristics of preying by night, and having their eyes formed for nocturnal vision. Their bodies are strong and muscular; their feet and claws made for tearing their prey; and their stomachs for digesting it. But, it must be remarked, that the digestion of all birds that live upon mice, lizards, or such like food, is not perfect; for, though they swallow them whole, yet some time after they disgorge the skin and bones, rolled up in a pellet, as being indigestible.

In proportion as each of these animals bears the daylight best, he sets forward earlier in the evening in pursuit of his prey. The great horned owl is the foremost in leaving his retreat; and ventures into the woods and thickets very soon in the evening. The horned and the brown owl are later in their excursions: but the barn-owl seems to see best in profound darkness: and seldom leaves his hiding-place till midnight.

As they are incapable of supporting day-light, or of then seeing and avoiding their danger, they keep all this time concealed in some retreat, suited to their appetites, and there continue in solitude and silence. The cavern of a rock, the darkest part of a hollow tree, the battlements of a ruined and unfrequented castle, some obscure hole in a farmer's out-house, are the places where they are usually found: if they be seen out of these retreats in the day-time, they may be considered as having lost their way; as having by some accident been thrown into the midst of their enemies, and surrounded with danger.

Having spent the day in their retreat, at the approach of evening they sally forth, and skim rapidly along the hedges. The barn-owl, who lives chiefly upon mice, is more stationary: he takes his residence upon some shock of corn, or the point of some old house; and there watches in the dark, with the utmost perspicacity and perseverance.

Nor are these birds by any means silent; they all have an hideous note; which, while pursuing their prey, is seldom heard; but may be considered rather as a call to courtship. There is something always terrifying in this call, which is often heard in the silence of midnight, and breaks the general pause with a horrid variation. It is different in all; but in each it is alarming and disagreeable. The screech-owl's voice was always considered among the people as a presage of some sad calamity that was soon to ensue.

They seldom are heard while they are preying, that pursuit being always attended with silence, as it is not their intention to disturb those little animals they wish to surprise. When they have been successful, they return to their solitude, or to their young, if that be the season. If, however, they find but little game, they continue their quest still longer; and it sometimes happens that, obeying the dictates of appetite rather than of prudence, they pursue so long that broad day breaks in upon them, and leaves them dazzled, bewildered, and at a distance from home.

In this distress they are obliged to take shelter in the first tree or hedge that offers, there to continue concealed all day, till the returning darkness supplies them with a better plan of the country. But it too often happens that, with all their precaution to conceal themselves, they are spied out by the other birds of the place, and are sure to receive no mercy. The blackbird, the thrush, the jay, the bunting, and the red-breast, all come in file, and employ their little arts of insult and abuse. The smallest, the feeblest, and the most contemptible of this unfortunate bird's enemies, are then the foremost to injure and torment him. They increase their cries and turbulence round him, flap him with their wings, and are ready to show their courage to be great, as they are sensible that their danger is but small. The unfortunate owl, not knowing where to attack or where to fly, patiently sits and suffers all their insults. Astonished and dizzy, he only replies to their mockeries by awkward and ridiculous gestures, turning his head and rolling his eyes with an air of stupidity. It is enough that an owl appears by day to set the whole grove into a kind of uproar. Either the aversion the small birds have to this animal, or the consciousness of their own security, makes them pursue him without ceasing, while they encourage each other by their mutual cries to lend assistance in this undertaking.

But it sometimes happens that the little birds pursue their insults with the same imprudent zeal with which the owl himself had pursued his depredations. They hunt him the whole day till evening returns; which restoring his faculties of sight once more, he makes the foremost of his pursuers pay dear for their sport; nor is man always an unconcerned spectator here. The bird-catchers have got an art for counterfeiting the cry of the owl exactly; and having before limed the branches of a hedge, they sit unseen and give the call. At this, all the little birds flock to the place where they expect to find their enemy; but instead of finding their stupid antagonist, they are stuck fast to the hedge themselves. This sport must be put in practice an hour before nightfall in order to be successful; for if it is delayed till later, those birds which but a few minutes sooner came to provoke their enemy, will then fly from him with as much terror as they just before showed insolence.

It is not unpleasant to see one stupid bird made, in some sort, a decoy to deceive another. The great horned owl is sometimes made use of for this purpose, to lure the kite when falconers desire to catch him for the purposes of training the falcon. Upon this occasion they clap the tail of a fox to the great owl to render his figure extraordinary, in which trim he sails slowly along, flying low, which is his usual manner. The kite, either curious to observe this odd kind of animal, or perhaps inquisitive to see whether it may not be proper for food, flies after, and comes nearer and nearer. In this manner he continues to hover, and sometimes to descend, till the falconer, setting a strong-winged hawk against him, seizes him for the purpose of training his young ones at home.

The usual place where the great horned owl breeds is in the cavern of a rock, the hollow of a tree, or the turret of some ruined castle. Its nest is near three feet in diameter, and composed of sticks, bound together by the fibrous roots of trees, and lined with leaves on the inside. It lays about three eggs, which are larger than those of a hen, and of a colour somewhat resembling the bird itself. The young ones are very voracious, and the parents not less expert in satisfying the call of hunger. The lesser owl of this kind never makes a nest for itself, but always takes up with the old nest of some other bird, which it has often been forced to abandon. It lays four or five eggs; and the young are all white at first, but change colour in about a fortnight. The other owls generally build near the place where they chiefly prey; that which feeds upon birds, in some neighbouring grove; that which preys chiefly upon mice, near some farmer's yard, where the proprietor of the place gives it perfect security. In fact, whatever mischief one species of fowl may do in the woods, the barn-owl makes a sufficient recompence for, by being equally active in destroying mice nearer home; so that a single owl is said to be more serviceable than half a dozen cats, in ridding the barn of its domestic vermin. 'In the year 1580,' says an old writer, 'at Hallontide, an army of mice so over-run the marshes near Southminster, that they eat up the grass to the very roots. But at length a great number of strange painted owls came and devoured all the mice. The like happened again in Essex about sixty years after.'

To conclude, these birds are all shy of man, and difficult to be tamed. The white owl in particular, as M. Buffon asserts, cannot be made to live in captivity; I suppose he means if it be taken when old. 'They live,' says he, 'ten or twelve days in the aviary where they are shut up; but they refuse all kind of nourishment, and at last die for hunger. By day they remain without moving from the floor of the aviary; in the evening they mount on the highest perch, where they continue to make a noise like a man snoring with his mouth open. This seems designed as a call for their old companions without; and, in fact, I have seen several others come to the call, and perch upon the roof of the aviary, where they made the same kind of hissing, and soon after permitted themselves to be taken in a net.'

OF BIRDS OF THE POULTRY KIND IN GENERAL.

WE shall make a transition from the most rapacious and noxious tribe of birds, to those which of all others are the most harmless and the most serviceable to man. He may force the rapacious tribes to assist his pleasures in the field, or induce the smaller warblers to delight him with their singing; but it is from the poultry kind that he derives the most solid advantages, as they not only make a considerable addition to the necessaries of life, but furnish out the greatest delicacies to every entertainment.

Almost, if not all the domestic birds of the poultry kind that we maintain in our yards, are of foreign extraction; but there are others to be ranked in this class that are as yet in a state of nature; and perhaps only wait till they become sufficiently scarce to be taken under the care of man to multiply their propagation. It will appear remarkable enough, if we consider how much the tame poultry which we have imported from distant climates has increased, and how much those wild birds of the poultry kind that have never yet been taken into keeping have been diminished and destroyed. They are all thinned; and many of the species, especially in the more cultivated and populous parts of the kingdom, are utterly unseen.

Under birds of the poultry kind I rank all those that have white flesh, and, comparatively to their head and limbs, have bulky bodies. They are furnished with short strong bills for picking up grain, which is their chief, and often their only sustenance. Their wings are short and concave; for which reason they are not able to fly far. They lay a great many eggs; and, as they lead their young abroad the very day they are hatched, in quest of food, which they are shown by the mother, and which they pick up for themselves, they generally make their nests upon the ground. The toes of all these are united by a membrane as far as the first articulation, and then are divided as in those of the former class.

Under this class we may rank the common cock, the peacock, the turkey, the pintada or Guinea hen, the pheasant, the bustard, the grous, the partridge, and the quail. These all bear great similitude to each other, being equally granivorous, fleshy, and delicate to the palate. These are among birds what beasts of pasture are among quadrupeds, peaceable tenants of the field, and shunning the thicker parts of the forest, that abounds with numerous animals, who carry on hostilities against them.

As nature formed the rapacious class for war, so she seems to have fitted these for peace, rest, and society. Their wings are but short, so that they are ill formed for wandering from one region to another; their bills are also short, and incapable of annoying their opposers; their legs are strong, but their toes are made for scratching up their food, and not for holding or tearing it. These are indications of their harmless nature; while their bodies, which are fat and fleshy, render them unwieldy travellers, and incapable of straying far from each other.

We therefore find them chiefly in society; they live together; and though they have their disputes, like other animals, yet when kept in the same district, or fed in the same yard, they learn the arts of subordination; and in proportion as each knows his strength, he seldom tries a second time the combat where he has once been worsted.

In this manner all of this kind seem to lead an indolent life; as they are furnished internally with a strong stomach, commonly called a gizzard, so their voraciousness scarcely knows any bounds. If kept in close captivity, and separated from all their former companions, they still have the pleasure of eating left; and they soon grow fat and unwieldy in their prison. To say this more simply, many of the wilder species of birds, when cooped or caged, pine away, grow gloomy, and some refuse all sustenance whatever; none, except those of the poultry kind, grow fat, who seem to lose all remembrance of their former liberty, satisfied with indolence and plenty.

The poultry kind may be considered as epicures, solely governed by their appetites. The indulgence of these seems to influence their other habits, and destroys that connubial fidelity for which most other birds are remarkable.

But it is very different with the class I am now describing. Their courtship is but short, and their congress fortuitous. The male takes no heed of his offspring; and satisfied with his commerce, leaves to the female the care of providing for posterity. Wild and irregular, he ranges from one to another; and claims every female which he is strong enough to keep from his fellows. Though timorous when opposed to birds of prey, yet he is incredibly bold among those of his own kind; and but to see a male of his own species is sufficient to produce a combat. As his desires extend to all, every creature becomes his enemy that pretends to be his rival.

The female, equally without fidelity or attachment, yields to the most powerful. She stands by, a quiet spectator of their fury, ready to reward the conqueror. She takes upon herself all the labour of hatching and bringing up her young, and chooses a place for hatching as remote as possible from the cock. Indeed she gives herself very little trouble in making a nest, as her young ones are to forsake it the instant they part from the shell.

She is equally unassisted in providing for her young, that are not fed with meat put into their mouths, as in other classes of the feathered kind, but peck their food, and forsaking their nests, run here and there, following the parent wherever it is to be found. She leads them forward where they are likely to have the greatest quantity of grain, and takes care to show by pecking, the sort proper for them to seek. At other times voracious she is then extremely abstemious; and intent only on providing for, and showing her young clutch their food, she scarcely takes any nourishment herself. Her parental pride overpowers every other appetite; but that decreases as her young ones are able to provide for themselves, and then her voracious habits return.

Among the other habits peculiar to this class of birds is that of dusting themselves. They lie flat in some dusty place, and with their wings and feet raise and scatter the dust over their whole body.

OF THE COCK.

All birds taken under the protection of man lose a part of their natural figure, and are altered not only in their habits but their form. Climate, food, and captivity, are three powerful agents in producing these alterations; and those birds that have longest felt their influence under human direction are most likely to have the greatest variety in their figures, plumage, and dispositions.

Of all other birds the cock seems to be the oldest companion of mankind, to have been first reclaimed from the forest, and taken to supply the accidental failure of the luxuries or necessities of life. As he is thus longest under the care of man, so of all others perhaps he exhibits the greatest number of varieties, there being scarcely two birds of this species that exactly resemble each other in plumage and form. The tail, which makes such a beautiful figure in the generality of these birds, is yet found entirely wanting in others; and not only the tail, but the rump also. The toes, which are usually four in all animals of the poultry kind, yet in a species of the cock are found to amount to five. The feathers which lie so sleek, and in such beautiful order in most of those we are acquainted with, are in a peculiar breed all inverted, and stand staring the wrong way. Nay there is a species that comes from Japan, which instead of feathers seems to be covered over with hair. These and many other varieties are to be found in this animal, which seem to be the marks this early prisoner bears of his long captivity.

It is not ascertained when the cock was first made domestic in Europe, but it is generally agreed that we first had him in our western world from the kingdom of Persia. Aristophanes calls the cock the *Persian bird,* and tells us, he enjoyed that kingdom before some of its earliest monarchs. This animal was in fact known so early even in the most savage parts of Europe, that we are told the cock was one of the forbidden foods among the ancient Britons. Indeed the domestic fowl seems to have banished the wild one. Persia itself, that first introduced it to our acquaintance, seems no longer to know it in its natural form; and if we did not find it wild in some of the woods of India, as well as those of the islands in the Indian ocean, we might begin to doubt, as we do with regard to the sheep, in what form it first existed in a state of nature.

But those doubts no longer remain; the cock is found in the island of Tinian, in many others of the Indian ocean, and in the woods on the coast of Malabar, in his ancient state of independence. In his wild condition his plumage is black and yellow, and his comb and wattles yellow and purple. There is another peculiarity also in those of the Indian woods; their bones, which when boiled with us are white, as every body knows, in those are as black as ebony. Whether this tincture proceeds from their food, as the bones are tinctured red by feeding upon madder, I leave to the discussion of others: satisfied with the fact we shall decline speculation.

In their first propagation in Europe, there were distinctions then that now subsist no longer. The ancients esteemed those fowls whose plumage was reddish as invaluable; but as for the white it was considered unfit for domestic purposes. These they regarded as subject to become a prey to rapacious birds; and Aristotle thinks them less fruitful than the former. Indeed his division of those birds seems to be taken from their culinary uses; the one sort he calls generous and noble, being remarkable for fecundity; the other, ignoble and useless, from their sterility. These distinctions differ widely from our notions of generosity in this animal; that which we call the *game-cock* being by no means so fruitful as the dunghill-cock, which we treat with contempt. The Athenians had their cock-matches as well as we: but it is probable they did not enter into our refinement of choosing out the most barren of the species for the purposes of combat.

But no animal in the world has greater courage than the cock, when opposed to one of his own species; and in every part of the world where refinement and polished manners have not entirely taken place, cock-fighting is a principal diversion. In China, India, the Philippine islands, and all over the East, cock-fighting is the sport and amusement even of kings and princes. With us it is declining every day; and it is to be hoped it will in time be given over.

This extraordinary courage in the cock is thought to proceed from his being the most salacious of all other birds whatsoever. A single cock suffices for ten or a dozen hens; and it is said that he is the only animal whose spirits are not abated by indulgence. But he soon grows old; the radical moisture is exhausted; and in three or four years he becomes unfit for that purpose. 'Hens also,' to use the words of Willoughby, 'as they for the greatest part of the year daily lay eggs, cannot suffice for so many births, but for the most part after three years become effete and barren: for when they have exhausted all their seed eggs, of which they had but a certain quantity from the beginning, they must necessarily cease to lay, there being no new ones generated within.'

The hen seldom clutches a brood of chickens above once a season, though instances have been known in which they have produced two. The number of eggs a domestic hen will lay in a year are above two hundred, provided she be well fed, and supplied with water and liberty. It matters not much whether she be trodden or not; she will continue to lay, although all the eggs of this kind can never produce a living animal. Her nest is made without any care, if left to herself; a hole scratched in the ground among a few bushes is the only preparation she makes for this season. Nature, almost exhausted by its own fecundity, seems to inform her of the proper time for hatching, which she herself testifies by a clucking note, and by discontinuing to lay. The good housewives, who often get more by their hens' laying than by their chickens, artificially protract this clucking season, and sometimes remove it. As soon as their hen begins to cluck, they stint her in her provisions; which if that fails, they plunge her into cold water; this for the time effectually puts back her hatching; but then it often kills the poor bird, who takes cold, and dies under the operation.

If left to herself the hen would seldom lay above twenty eggs in the same nest without attempting to hatch them; but in proportion as she lays, her eggs are removed; and she continues to lay, vainly hoping to increase the number; in the wild state the hen seldom lays above fifteen eggs; but then her provision is more difficultly obtained, and she is perhaps sensible of the difficulty of maintaining too numerous a family.

When the hen begins to sit, nothing can exceed her perseverance and patience; she continues for some days immovable; and when forced away by the importunities of hunger, she quickly returns. Sometimes her eggs become too hot for her to bear, especially if she be furnished with too warm a nest within doors, for then she is obliged to leave them to cool a little; thus the warmth of the nest only retards incubation, and often puts the brood a day or two back in the shell. While the hen sits, she carefully turns her eggs, and removes them to different situations; till at length, in about three weeks, the young brood begins to give signs of a desire to burst their confinement. When, by the repeated efforts of their bill, they have broke themselves a passage through the shell, the hen still continues to sit till all are excluded. The strongest and best chickens generally are the first candidates for liberty: the weakest come behind, and some even die in the shell. When all are produced, she then leads them forth to provide for themselves. Her affection and her pride seem then to alter her very nature, and correct her imperfections. No longer voracious or cowardly, she abstains from all food that her young can swallow, and flies boldly at every creature that she thinks likely to do them mischief. Whatever the invading animal be, she boldly attacks him; the horse, the hog, or the mastiff. When marching at the head of her little troop, she acts the commander, and has a variety of notes to call her train to their food, or to warn them of approaching danger. Upon one of these occasions, I have seen the whole brood run for security into the thickest part of a hedge, when the hen herself ventured boldly forth, and faced a fox that came for plunder. With a good mastiff, however, we soon sent the invader back to his retreat; but not before he had wounded the hen in several places.

Ten or twelve chickens are the greatest number that a good hen can rear and clutch at a time; but as this bears no proportion to the number of her eggs, schemes have been imagined to clutch all the eggs of a hen, and thus turn her produce to the greatest advantage. By these contrivances it has been obtained that a hen that ordinarily produces but twelve chickens in the year, is found to produce as many chickens as eggs, and consequently often above two hundred. The contrivance I mean is the artificial method of hatching chickens in stoves, as is practised at Grand Cairo; or in a chymical elaboratory properly graduated, as has been effected by Mr. Reaumur. At Grand Cairo, they thus produce six or seven thousand chickens at a time; where, as they are brought forth in their mild spring, which is warmer than our summer, the young ones thrive without clutching. But it is otherwise in our colder and unequal climate; the little animal may, without much difficulty, be hatched from the shell; but they almost all perish when excluded. To remedy this, Reaumur has made use of a woollen hen, as he calls it; which was nothing more than putting the young ones in a warm basket, and clapping over them a thick woollen canopy. I should think a much better substitute might be found; and this from among the species themselves. Capons may easily be taught to clutch a fresh brood of chickens throughout the year; so that when one little colony is thus reared, another may be brought to succeed it. Nothing is more common than to see capons thus employed; and the manner of teaching them is this: first the capon is made very tame, so as to feed from one's hand; then, about evening, they pluck the feathers off his breast, and rub the bare skin with nettles; they then put the chickens to him, which presently run under his breast and belly, and probably rubbing his bare skin gently with their heads allay the stinging pain which the nettles had just produced. This is repeated for two or three nights, till the animal takes an affection to the chickens that have thus given him relief, and continues to give them the protection they seek: perhaps the querulous voice of the chickens may be pleasant to him in misery, and invite him to succour the distressed. He from that time brings up a brood of chickens like a hen, clutching them, feeding them, clucking, and performing all the functions of the tenderest parent. A capon once accustomed to this service, will not give over; but when one brood is grown up, he may have another nearly hatched put under him, which he will treat with the same tenderness he did the former.

The cock, from his salaciousness, is allowed to be a short lived animal; but how long these birds live, if left to themselves, is not yet well ascertained by any historian. As they are kept only for profit, and in a few years become unfit for generation, there are few that, from mere motives of curiosity, will make the tedious experiment of maintaining a proper number till they die. Aldrovandus hints their age to be ten years; and probably this may be its extent.

OF THE PEACOCK.

The Peacock, by the common people of Italy, is said to have the plumage of an angel, the voice of a devil, and the guts of a thief. In fact, each of these qualities mark pretty well the nature of this bird. When its tail is expanded, there is none of the feathered creation can vie with it for beauty; yet the horrid scream of its voice serves to abate the pleasure we find from viewing it; and still more, its insatiable gluttony and spirit of depredation, make it one of the most noxious domestics that man has taken under his protection.

Our first peacocks were brought from the East Indies; and we are assured, that they are still found in vast flocks in a wild state, in the islands of Java and Ceylon. So beautiful a bird, and one esteemed such a delicacy at the tables of the luxurious, could not be permitted to continue long at liberty in its distant retreats. So early as the days of Solomon, we find in his navies, among the articles imported from the east, apes, and peacocks. Ælian relates, that they were brought into Greece from some barbarous country, and were held in such high esteem among them, that a male and female were valued at above thirty pounds of our money. We are told also, that when Alexander was in India, he found them flying wild, in vast numbers, on the banks of the river Hyarotis, and was so struck with their beauty, that he laid a severe fine and punishment on all who should kill or disturb them. Nor are we to be surprised at this, as the Greeks were so much struck with the beauty of this bird, when first brought among them, that every person paid a fixed price for seeing it; and several people went to Athens, from Lacedæmon and Thessaly, purely to satisfy their curiosity.

It was probably first introduced into the West, merely on account of its beauty; but mankind, from contemplating its figure, soon thought of serving it up for a different entertainment. Aufidius Hurco is charged by Pliny with being the first who fatted up the peacock for the feasts of the luxurious. Whatever there may be of delicacy in the flesh of a young peacock, it is certain an old one is very indifferent eating; nevertheless, there is no mention made of choosing the youngest: it is probable they were killed indiscriminately, the beauty of the feathers in some measure stimulating the appetite. Hortensius, the orator, was the first who served them up in an entertainment at Rome; and afterwards they were considered as one of the greatest ornaments of every feast. Whether the Roman method of cookery, which was much higher than ours, might not have rendered them more palatable than we find them at present, I cannot tell: but certain it is, they talk of the peacock as being the first of viands.

But its fame for delicacy did not continue long; for, in the time of Francis the First, it was a custom to serve up peacocks to the tables of the great, with an intention not to be eaten, but only to be seen. Their manner was to strip off the skin; and then preparing the body with the warmest spices, they covered it up again in its former skin, with all its plumage in full display, and no way injured by the preparation. The bird thus prepared, was often preserved for many years without corrupting; and it is asserted of the peacock's flesh, that it keeps longer unputrefied than that of any other animal. To give a higher zest to these entertainments, on weddings particularly, they filled the bird's beak and throat with cotton and camphire, which they set on fire, to amuse and delight the company.

Like other birds of the poultry kind, the peacock feeds upon corn, but it is chiefly fond of barley. But as it is a very proud and fickle bird, there is scarcely any food that it will not at times covet and pursue. Insects and tender plants are often eagerly sought at a time that it has a sufficiency of its natural food provided more nearly. In the indulgence of these capricious pursuits, walls cannot easily confine it, it strips the tops of houses of their tiles or thatch, it lays waste the labours of the gardener, roots up his choicest seeds, and nips his favourite flowers in the bud. Thus its beauty but ill recompenses for the mischief it occasions; and many of the more homely looking fowls are deservedly preferred before it.

Nor is the peacock less a debauchee in its affections, than a glutton in its appetites. He is still more salacious than even the cock; and though not possessed of the same vigour, yet burns with more immoderate desire.

The peahen seldom lays above five or six eggs in this climate before she sits. Aristotle describes her as laying twelve; and, probably, in her native climate, she may be thus prolific; for it is certain, that in the forests where they breed naturally, they are numerous beyond expression. The bird lives about twenty years; and not till its third year has it that beautiful variegated plumage that adorns its tail.

'In the kingdom of Cambaya,' says Tavernier, 'near the city of Baroch, whole flocks of them are seen in the fields. They are very shy, however, and it is impossible to come near them. They run off swifter than the partridge; and hide themselves in the thickets, where it is impossible to find them. They perch by night upon trees; and the fowler often approaches them at that season with a kind of banner, on which a peacock is painted to the life on either side. A lighted torch is fixed on the top of this decoy; and the peacock, when disturbed, flies to what it takes for another, and is thus caught in a nooze, prepared for that purpose.'

There are varieties of this bird, some of which are white, others crested; that which is called the *Peacock of Thibet*, is the most beautiful of the feathered creation, containing in its plumage all the most vivid colours, red, blue, yellow, and green, disposed in an almost artificial order, as if merely to please the eye of the beholder.

THE TURKEY.

Concerning the natal place of the turkey there are strong doubts; some contending that it has been brought into Europe from the East Indies many centuries ago; while others assert, that it is wholly unknown in that part of the world, that it is a native of the New Continent, and that it was not brought into Europe till the discovery of that part of the world.

Those who contend for the latter opinion, very truly observe, that among all the descriptions we have of eastern birds, that of the turkey is not to be found; while, on the contrary, it is well known in the New Continent, where it runs wild about the woods. It is said by them to have been first seen in France, in the reign of Francis I. and in England, in that of Henry VIII. which is about the time when Mexico was first conquered by Spain. On the other hand, it is asserted, that the turkey, so far from being unknown in Europe before that time, was known even to the ancients; and that Ælian has given a pretty just description of it. They alledge, that its very name implies its having been brought from some part of the east; and that it is found among other dainties, served up to the tables of the great, before that time among ourselves. But what they pretend to be the strongest proof is, that though the wild turkey be so common in America, yet the natives cannot contrive to tame it; and though hatched in the ordinary manner, nothing can render it domestic. In this diversity of opinions perhaps it is best to suspend assent, till more lights are thrown on the subject; however, I am inclined to concur with the former opinion.

With us, when young, it is one of the tenderest of all birds; yet in its wild state it is found in great plenty in the forests of Canada, that are covered with snow above three parts of the year. In their natural woods they are found much larger than in their state of domestic captivity. They are much more beautiful also, their feathers being of a dark grey, bordered at the edges with a bright gold colour. These the savages of the country weave into cloaks to adorn their persons, and fashion into fans and umbrellas, but never once think of taking into keeping animals that the woods furnish them with in sufficient abundance. Savage man seems to find a delight in precarious possession. A great part of the pleasure of the chase lies in the uncertainty of the pursuit, and he is unwilling to abridge himself in any accidental success that may attend his fatigues. The hunting the turkey, therefore, makes one of his principal diversions; as its flesh contributes chiefly to the support of his family. When he has discovered the place of their retreat, which in general is near fields of nettles, or where there is plenty of any kind of grain, he takes his dog with him, which is trained to the sport, (a faithful, rough creature, supposed to be originally reclaimed from the wolf,) and he sends him into the midst of the flock. The turkies no sooner perceive their enemy than they set off running at full speed, and with such swiftness, that they leave the dog far behind them; he follows, nevertheless, and sensible they must soon be tired, as they cannot go full speed for any length of time, he at last forces them to take shelter in a tree, where they sit quite spent and fatigued till the hunter comes up, and with a long pole knocks them down, one after the other

This manner of suffering themselves to be destroyed, argues no great instinct in the animal; and indeed in their captive state they do not appear to be possessed of much. They seem a stupid, vain, querulous tribe, apt enough to quarrel among themselves, yet without any weapons to do each other any injury. Every body knows the strange antipathy the turkey-cock has to a red colour; how he bristles, and with its peculiar gobbling sound flies to attack it. But there is another method of increasing the animosity of these birds against each other, which is often practised by boys, when they have a mind for a battle. This is no more than to smear over the head of one of the turkeys with dirt, and the rest run to attack it with all the speed of impotent animosity; nay two of them thus disguised will fight each other till they are almost suffocated with fatigue and anger.

Although so furious among themselves, they are weak and cowardly against other animals, though far less powerful than they. With great insolence he pursues any thing that seems to fear him, particularly lap-dogs and children, against both which he seems to have a peculiar aversion. On such occasions, after he has made them fly, he returns to his female train, displays his plumage around, struts about the yard, and gobbles out a note of self-approbation.

The female seems of a milder disposition. Rather querulous than bold, she hunts about in quest of grain, and pursuit of insects, being particularly delighted with the eggs of ants and caterpillars. She lays eighteen or twenty eggs, larger than those of a hen, whitish, but marked with spots resembling freckles of the face. Her young are extremely tender at first, and must be carefully fed with curd chopped with dock leaves; but as they grow older, they become more hardy, and follow the mother to considerable distances, in pursuit of insect food, which they prefer to any other. On these occasions, the female, though so large, and, as it would seem, so powerful a bird, gives them but little protection against the attacks of any rapacious animal that comes in her way. She rather warns her young to shift for themselves, than prepares to defend them. 'I have heard,' says the Abbé la Pluche, 'a turkey-hen, when at the head of her brood, send forth the most hideous screams, without knowing as yet the cause: however, her young, immediately when the warning was given, skulked under the bushes, the grass, or whatever else offered for shelter or protection. They even stretched themselves at their full length upon the ground, and continued lying as motionless as if they were dead. In the mean time the mother, with her eyes directed upwards, continued her cries and screaming as before. Upon looking up to where she seemed to gaze, I discovered a black spot just under the clouds, but was unable at first to determine what it was; however, it soon appeared to be a bird of prey, though at first at too great a distance to be distinguished. I have seen one of these animals continue in this violent, agitated state, and her whole brood pinned down as it were to the ground, for four hours together; whilst their formidable foe has taken his circuits, has mounted, and hovered directly over their heads: at last, upon disappearing, the parent began to change her note, and sent forth another cry, which in an instant gave life to the whole trembling tribe, and they all flocked round her with expressions of pleasure, as if conscious of their happy escape from danger.'

When once grown, up turkeys are hardy birds, and feed themselves at little expence to the farmer. Those of Norfolk are said to be the largest of this kingdom, weighing from twenty to thirty pounds. But there are places in the East Indies, where they are known only in their domestic state, in which they grow to the weight of sixty pounds.

THE PHEASANT.

It would surprise a sportsman to be told, that the pheasant, which he finds wild in the woods, in the remotest parts of the kingdom, and in forests which can scarcely be said to have an owner, is a foreign bird, and was at first artificially propagated among us. They were brought into Europe from the banks of the Phasis, a river of Colchis in Asia Minor; and whence they still retain their name.

Next to the peacock they are the most beautiful of birds, as well for the vivid colour of their plumes as for their happy mixtures and variety. It is far beyond the power of the pencil to draw any thing so glossy, so bright, or points so finely blending into each other. We are told that when Crœsus, king of Lydia, was seated on his throne, adorned with royal magnificence and all the pomp of eastern splendour, he asked Solon if he had ever beheld any thing so fine? The Greek philosopher, no way moved by the objects before him, or taking a pride in his native simplicity, replied, that after having seen the beautiful plumage of the pheasant, he could be astonished at no other finery.

In fact nothing can satisfy the eye with a greater variety and richness of ornament than this beautiful creature. The iris of the eye is yellow; and the eyes themselves are surrounded with a scarlet colour, sprinkled with small specks of black. On the fore part of the head there are blackish feathers mixed with a shining purple. The top of the head and the upper part of the neck are tinged with a darkish green that shines like silk. In some, the top of the head is of a shining blue, and the head itself, with the upper part of the neck, appears sometimes blue and sometimes green, as it is differently placed to the eye of the spectator. The feathers of the breast, the shoulders, the middle of the back, and the sides under the wings, have a blackish ground, with edges tinged of an exquisite colour, which appears sometimes black and sometimes purple, according to the different lights it is placed in; under the purple there is a transverse streak of gold colour. The tail, from the middle feathers to the root, is about eighteen inches long; the legs, the feet, and the toes, are of the colour of horn. There are black spurs on the legs, shorter than those of a cock; there is a membrane that connects two of the toes together; and the male is much more beautiful than the female.

This bird, though so beautiful to the eye, is not less delicate when served up to the table. Its flesh is considered as the greatest dainty; and when the old physicians spoke of the wholesomeness of any viands, they made their comparison with the flesh of the pheasant. But notwithstanding all these perfections to tempt the curiosity or the palate, the pheasant has multiplied in its wild state; and, as if disdaining the protection of man, has left him to take shelter in thick woods and remote forests. All others of the domestic kind, the cock, the turkey, or the pintada, when once reclaimed, have still continued in their domestic state, and persevered in the habits and appetites of slavery. But the pheasant, though taken from its native warm retreats, where the woods supply variety of food, and the warm sun suits its tender constitution, has still continued its attachment to native freedom; and now wild among us, makes the most envied ornament of our parks and forests, where he feeds upon acorns and berries, and the scanty produce of our chilling climate.

This spirit of independence seems to attend the pheasant even in captivity. In the woods the hen pheasant lays from eighteen to twenty eggs in a season; but in a domestic state she seldom lays above ten. In the same manner, when wild she hatches and leads up her brood with patience, vigilance, and courage; but when kept tame, she never sits well; so that a hen is generally her substitute upon such occasions; and as for her leading her young to their food, she is utterly ignorant of where it is to be found; and the young birds starve if left solely to her protection. The pheasant, therefore, on every account, seems better left at large in the woods, than reclaimed to pristine captivity. Its fecundity when wild is sufficient to stock the forest; its beautiful plumage adorns it; and its flesh retains a higher flavour from its unlimited freedom.

It has been the aim of late to take these birds once more from the woods, and to keep them in places fitted for their reception. Like others of the poultry kind, they have no greater sagacity, and suffer themselves to be easily taken. At night they roost upon the highest trees of the wood; and by day they come down into the lower brakes and bushes, where their food is chiefly found. They generally make a kind of flapping noise when they are with the females; and this often apprizes the sportsman of their retreats. At other times he traces them in the snow, and frequently takes them in springes. But of all birds they are shot most easily, as they always make a whirring noise, when they rise, by which they alarm the gunner, and being a large mark, flying very slow, there is scarce any missing them.

> "Ah! what avail his glossy, varying dyes,
> His purpled crest, and scarlet circled eyes,
> The vivid green his shining plumes unfold,
> His painted wings, and breast that flames with gold?"
> Pope.

When these birds are taken young into keeping, they become as familiar as chickens; but when designed for breeding, they are put together into a yard, five hens to a cock; for this bird like all of the poultry kind, is very salacious. In her natural state the female makes her nest of dry grass and leaves; the same must be laid for her in the pheasandry, and she herself will sometimes properly dispose them. If she refuses to hatch her eggs, then a common hen must be got to supply her place, which task she will perform with success. The young ones are difficult to be reared; and they must be supplied with ants' eggs, which is the food the old one leads them to gather when wild in the woods. To make these go the farther, they are to be chopped up with curds or other meat; and the young ones are to be fed with great exactness, both as to the quantity and the time of their supply. This food is sometimes also to be varied, and wood-lice, earwigs, and other insects, are to make a variety. The place where they are reared must be kept extremely clean; their water must be changed twice or thrice a day; they must not be exposed till the dew is off the ground in the morning; and they should always be taken in before sun-set. When they become adult, they can shift for themselves, but are particularly fond of oats and barley.

To increase the breed, and make it still more valuable, Longolius teaches us a method that appears very peculiar. The pheasant is a bold bird when first brought into the yard among other poultry, not sparing the peacock, nor such young cocks and hens as it can master; but after a time it will live tamely among them, and at last be brought to couple with a common hen. The breed thus produced takes much stronger after the pheasant than the hen; and in a few successions, if they be left to breed with the cock-pheasant, for the mixture is not barren, there will be produced a species more tame, stronger, and prolific; so that, he adds, it is strange why most of our pheasandries, are not stocked with birds thus produced.

Of the pheasant, as of all other domestic fowls, there are many varieties. There are white pheasants, crested pheasants, spotted pheasants, but the golden pheasant of China is the most beautiful. It is a doubt whether the peacock itself can bear the comparison. However, the natives of China would not have us consider it as their most beautiful bird, though covered all over with eyes, resembling in miniature those of the peacock. By their accounts, it is far exceeded by the fongwang, an imaginary bird, of which they give a most fantastic description.

THE PINTADA, OR GUINEA-HEN.

This is a remarkable bird, and in some measure unites the characteristics of the pheasant and the turkey. It has the fine delicate shape of the one, and the bare head of the other. It is about the size of a common hen, but as it is supported on longer legs, it looks much larger. It has a round back, with a tail turned downwards like a partridge. The head is covered with a kind of casque; and the whole plumage is black or dark grey, speckled with white spots. It has wattles under the bill, which do not proceed from the lower chap as in cocks, but from the upper, which give it a very peculiar air; while its restless gait and odd chuckling sound distinguish it from all other birds.

It is well known all over Europe, and even better than with us, as the nations that border on the Mediterranean probably had it before us from those parts of Africa which lay nearest. Accordingly we find it in different countries called by different names, from the place whence they had it. They are by some called the *Barbary-hen;* by others, the *tamis-bird;* and by others, the *bird of Numidia.* We have given it the name of that part of Africa from whence probably it was first brought to this country.

In many parts of Africa they are seen in vast flocks together, feeding their young, and leading them in quest of food. All their habits are like those of the poultry kind, and they agree in every other respect, except that the male and female are so much alike, that they can hardly be distinguished asunder. The only difference lies in the wattles described above; which in the cock are of a bluish cast; in the hen, they are more inclining to a red. Their eggs, like their bodies, are speckled; in our climate, they lay but five or six in a season; but they are far more prolific in their sultry regions at home. They are kept among us rather for show than use, as their flesh is not esteemed, and as they give a good deal of trouble in the rearing.

THE BUSTARD.

The Bustard is the largest land-bird that is a native of Britain. It was once much more numerous than it is at present; but the increased cultivation of the country, and the delicacy of its flesh, has greatly thinned the species; so that, at a future period, it may be doubted whether so large a bird was bred among us. It is probable that long ere this the bustard would have been extirpated, but for its peculiar manner of feeding. Had it continued to seek shelter among our woods, in proportion as they were cut down, it must have been destroyed. If in the forest, the fowler might approach it without being seen; and the bird, from its size, would be too great a mark to be easily missed. But it inhabits only the open and extensive plain, where its food lies in abundance, and where every invader may be seen at a distance.

The bustard is much larger than the turkey, the male generally weighing from twenty-five to twenty-seven pounds. The neck is a foot long, and the legs a foot and a half. The wings are not proportionable to the rest of the body, being but four feet from the tip of the one to the other; for which reason the bird flies with difficulty. The head and neck of the male are ash-coloured; the back is barred transversely with black, bright, and rust colour. The greater quill feathers are black; the belly white; and the tail, which consists of twenty feathers, is marked with broad black bars.

It would seem odd, as was hinted before, how so large a land-bird as this could find shelter in so cultivated a country as England; but the wonder will cease when we find it only in the most open countries, where there is scarcely any approaching without being discovered. They are frequently seen in flocks of fifty or more, in Salisbury Plain, in the heaths of Sussex and Cambridgeshire, the Dorsetshire uplands, and so on as far as East Lothian in Scotland. In those extensive plains, where there are no woods to screen the sportsman, nor hedges to creep along, the bustards enjoy an indolent security. Their food is composed of the berries that grow among the heath, and the large earth-worms that appear in great quantities on the downs before sun-rising in summer. It is in vain that the fowler creeps forward to approach them, they have always centinels placed at proper eminences, which are ever on the watch, and warn the flock of the smallest appearance of danger. All that is left the sportsman, is the comfortless view of their distant security.

It sometimes happens that these birds, though they are seldom shot, are often run down by grey-hounds. As they are voracious and greedy, they often sacrifice their safety to their appetite, and feed themselves so fat, that they are unable to fly without great preparation. When the grey-hound, therefore, comes within a certain distance, the bustard runs off flapping its wings, and endeavouring to gather air enough under them to rise; in the mean time the enemy approaches nearer and nearer, till it is too late for the bird even to think of obtaining safety by flight; for just at the rise there is always time lost, and of this the bird is sensible; it continues, therefore, on the foot till it has got a sufficient way before the dog for flight, or until it is taken.

As there are few places where they can at once find proper food and security, so they generally continue near their old haunts, seldom wandering above twenty or thirty miles from home. Their food being replete with moisture, enables them to live upon these dry plains, (where there are scarcely any springs of water,) a long time without drinking. Besides this, Nature has given the males an admirable magazine for their security against thirst. This is a pouch, the entrance of which lies immediately under the tongue, and capable of holding near seven quarts of water. This is probably filled upon proper occasions, to supply the hen when sitting, or the young before they can fly.

Like all other birds of the poultry kind, they change their mates at the season of incubation, which is about the latter end of summer. They separate in pairs if there be a sufficiency of females for the males; but when this happens to be otherwise, the males fight until one of them falls.—In France, they often find some of those victims to gallantry dead in the fields, and no doubt are not displeased at the occasion.

They make their nests upon the ground, only just scraping a hole in the earth, and sometimes lining it with a little long grass or straw. There they lay two eggs only, almost of the size of a goose egg, of a pale olive brown, marked with spots of a darker colour. They hatch in about five weeks, and the young ones run about as soon as they are out of the shell.

The bustards assemble in flocks in October, and keep together till April. In winter, as their food becomes scarce, they support themselves by feeding on moles, mice, and even little birds, when they can seize them. For want of other food they are contented to live upon turnip leaves, and such succulent vegetables. In some parts of Switzerland, they are found frozen in the fields in severe weather; but when taken to a warm place, they recover. They usually live fifteen years, and are incapable of being propagated in a domestic state, as they probably want that food which best agrees with their appetite.

THE GROUS AND ITS AFFINITIES.

The Cock of the Wood, the Black Cock, the Grous, and the Ptarmigan—These are all birds of a similar nature, and chiefly found in heathy mountains and piny forests, at a distance from mankind. They might once indeed have been common enough all over England, when a great part of the country was covered with heath; but at present their numbers are thinned: the two first of this kind are utterly unknown to the south, and have taken refuge in the northern parts of Scotland, where the extensive heaths afford them security, and the forests shelter.

The cock of the wood is sometimes of the size of a turkey, and often weighs near fourteen pounds; the black cock, of which the male is all over black, though the female is of the colour of a partridge, is about the size of a hen, and, like the former, is only found with us in the Highlands of Scotland: the grous is about half as large again as a partridge, and its colour much like that of a woodcock, but redder; the ptarmigan is still somewhat less, and of a pale brown or ash-colour. They are all distinguishable from other birds of the poultry kind, by a naked skin, of a scarlet colour above the eyes, in the place and of the figure of eye-brows.

It seems to be something extraordinary, that all the larger wild animals of every species choose the darkest and the inmost recesses of the woods for their residence, while the smaller kinds come more into the open and cultivated parts, where there is more food and more danger. It is thus with the birds I am describing: while the cock of the wood is seldom seen, except on the inaccessible parts of the heathy mountains, or in the midst of piny forests, the grous is found, in great numbers, in the neighbourhood of corn fields, where there is heath to afford retreat and shelter. Their food too somewhat differs; while the smaller kind lives upon heath blossoms, cranberries, and corn, the larger feeds upon the cones of the pine-tree; and will sometimes strip one tree, before it offers to touch those of another, though just beside him. In other respects the manners of these birds are the same; being both equally simple in their diet, and licentious in their amours.

The cock of the wood, for it is from him we will take our description, is, as was said, chiefly fond of a mountainous and woody situation. In winter he resides in the darkest and inmost part of the woods; in summer he ventures down from his retreats, to make short depredations on the farmer's corn. The delicacy of his flesh in some measure sets a high price upon his head; and as he is greatly sought after, so he continues, when he comes down from the hills, always on his guard. Upon these occasions he is seldom surprised; and those who would take him must venture to find him in his native retreats.

The cock of the wood, when in the forest, attaches himself principally to the oak and pine-tree; the cones of the latter serving for his food, and the thick boughs for a habitation. He feeds also upon ants' eggs, which seem a high delicacy to all birds of the poultry kind: cranberries are likewise found in his crop; and his gizzard, like that of domestic fowls, contains a quantity of gravel, for the purposes of assisting his powers of digestion.

At the earliest return of spring this bird begins to feel the genial influence of the season. During the month of March the approaches of courtship are continued, and do not desist till the trees have all their leaves, and the forest is in full bloom. During this season the cock of the wood is seen at sun-rise, and sitting extremely active upon one of the largest branches of the pine tree. With his tail raised and expanded like a fan, and the wings drooping, he walks backward and forward, his neck stretched out, his head swollen and red, and making a thousand ridiculous postures; his cry upon that occasion is a kind of loud explosion, which is instantly followed by a noise like the whetting of a scythe, which ceases and commences alternately for about an hour, and then terminates by the same explosion.

During the time this singular cry continues, the bird seems deaf, and insensible of every danger; whatever noise may be made near him, or even though fired at, he still continues his call; and this is the time that sportsmen generally take to shoot him. Upon all other occasions he is the most timorous and watchful bird in nature; but now he seems absorbed by his instincts, and seldom leaves the place where he first begins to feel the accesses of desire. This extraordinary cry, which is accompanied by a clapping of the wings is no sooner finished, than the female hearing it replies, approaches, and places herself under the tree, from whence the cock descends to embrace her. The number of females that resort to his call is uncertain; but one male generally suffices for all.

The female is much less than her mate, and entirely unlike him in plumage, so that she might be mistaken for a bird of another species; she seldom lays more than six or seven eggs, which are white, and marked with yellow, of the size of a common hen's egg; she generally lays them in a dry place, and a mossy ground, and hatches them without the company of the cock. When she is obliged, during the time of incubation, to leave her eggs in quest of food, she covers them up so artfully with moss or dry leaves, that it is extremely difficult to discover them. On this occasion, she is tame and tranquil, however wild and timorous in ordinary. She often keeps to her nest, though strangers attempt to drag her away.

When the young ones are hatched they are seen running with agility after the mother, though sometimes they are not entirely disengaged from the shell. The hen leads them forward, for the first time, into the woods, shows them ants' eggs, and the wild mountain-berries, which, while young, are their only food. As they grow older their appetites grow stronger, and they feed upon the tops of hether, and the cones of the pine-tree. In this manner they soon come to perfection: they are a hardy bird, their food lies every where before them, in great abundance. But their numbers are thinned by rapacious birds and beasts of every kind; and still more by their own salacious contests.

As soon as the clutching is over, which the female performs in the manner of a hen, the whole brood follows the mother for about a month or two; at the end of which the young males forsake her, and keep in great harmony together till the beginning of spring. At this season they begin, for the first time, to feel the genial access; and then adieu to all their former friendships! They begin to consider each other as rivals; and the rage of concupiscence extinguishes the spirit of society. They fight each other like game cocks; and at that time are so inattentive to their own safety, that it often happens that two or three of them are killed at a shot. Probably in these contests the bird which comes off victorious takes possession of the female seraglio, as it is certain they have no faithful attachments.

OF THE PARTRIDGE AND ITS VARIETIES.

The partridge may be particularly considered as belonging to the sportsman. It is a bird which even our laws have taken under protection; and, like a peacock or a hen, may be ranked as a private property. The only difference now is, that we feed one in our farms, the other in our yards: that these are contented captives; those, servants that have it in their power to change their master, by changing their habitation.

In England, where the partridge is scarcer than in France, and a great deal dearer, it is a favourite delicacy at the tables of the rich; and the desire of keeping it to themselves has induced them to make laws for its preservation, no way harmonizing with the general spirit of the English legislation. What can be more arbitrary than to talk of preserving the game; which, when defined, means no more than that the poor shall abstain from what the rich have taken a fancy to keep to themselves? If these birds could, like a cock or a hen, be made legal property, could they be taught to keep within certain districts, and only feed on those grounds that belong to the man whose entertainments they improve, it then might, with some show of justice, be admitted, that as a man fed them, so he might claim them. But this is not the case; nor is it in any man's power to lay a restraint upon the liberty of these birds, that when let loose, put no limits to their excursions. They feed every where; upon every man's ground; and no man can say these birds are fed only by me. Those birds which are nourished by all belong to all; nor can any one man, or any set of men, lay claim to them when still continuing in a state of nature.

I never walked out about the environs of Paris, that I did not consider the immense quantity of game that was running almost tame on every side of me as a badge of the slavery of the people; and what they wished me to observe as an object of triumph, I always regarded with a kind of secret compassion; yet this people have no game laws for the remoter parts of the kingdom; the game is only preserved in a few places for the king, and is free in most places else. In England the prohibition is general; and the peasant has not a right to what even slaves, as he is is taught to call them, are found to possess.

Of partridges there are two kinds, the grey and the red. The red partridge is the largest of the two, and often perches upon trees; the grey, with which we are best acquainted in England, is most prolific, and always keeps on the ground.

The partridge seems to be a bird well known all over the world, as it is found in every country and in every climate; as well in the frozen regions about the pole, as the torrid tracts under the equator. It even seems to adapt itself to the nature of the climate where it resides. In Greenland the partridge, which is brown in summer, as soon as the icy winter sets in, begins to take a covering suited to the season: it is then clothed with a warm down beneath; and its outward plumage assumes the colour of the snows amongst which it seeks its food. Thus it is doubly fitted for the place by the warmth and the colour of its plumage; the one to defend it from the cold, the other to prevent its being noticed by the enemy. Those of Barakonda, on the other hand, are longer-legged, much swifter of foot, and choose the highest rocks and precipices to reside in.

But they all agree in one character, of being immoderately addicted to venery. It is certain the male will pursue the hen even to her nest, and break her eggs, rather than be disappointed. Though the young ones have kept together in flocks during the winter, when they begin to pair in spring, their society disperses, and terrible combats with respect to each other ensue. Their manners, in other circumstances, resemble all those of poultry in general; but their cunning and instincts seem superior to those of the larger kinds. Perhaps, as they live in the neighbourhood of their enemies, they have more frequent occasion to put their little arts in practice; and learn by habit the means of safety. Whenever, therefore, a dog, or other formidable animal, approaches their nest, the female uses every means to draw him away. She keeps just before him, pretends to be incapable of flying, just hops up, and then falls down before him, but never goes off so far as to discourage her pursuer. At length, when she has drawn him entirely away from her secret treasure, she takes wing, and leaves him to gaze after her in despair.

After the danger is over, and the dog withdrawn, she calls her young, who assemble at once at her cry, and follow where she leads them. There are generally from ten to fifteen in a covey; and if unmolested they live from fifteen to seventeen years.

There are several methods of taking them, as is well known; that by which they are taken in a net with a setting-dog is the most pleasant, as well as the most secure. The dog is trained to this exercise by a long course of education; by blows and caresses he is taught to lie down at the word of command: a partridge is shown him, and he is then ordered to lie down; he is brought into the field, and when the sportsman perceives where the covey lies, he orders his dog to crouch: at length the dog, from habit, crouches wherever he approaches a covey; and this is the signal which the sportsman receives for unfolding and covering the birds with his net. A covey thus caught is sometimes fed in a place proper for their reception; but they can never be thoroughly tamed like other domestic poultry.

THE QUAIL.

The last of the poultry kind that I shall mention is the quail; a bird much smaller than any of the former, being not above half the size of a partridge. The feathers of the head are black, edged with rusty brown; the breast is of a pale yellowish red, spotted with black; the feathers on the back are marked with lines of a pale yellow, and the legs are of a pale hue. Except in the colours thus described, and the size, it resembles a partridge in shape; and except that it is a bird of passage, all others of the poultry kind in its habits and nature.

The quail is known to be a bird of passage; and yet if we consider its heavy manner of flying, and its dearth of plumage, with respect to its corpulence, we shall be surprised how a bird so apparently ill qualified for migration, should take such extensive journies. But nothing is more certain: 'When we sailed from Rhodes to Alexandria,' says Bellonius, 'about autumn, many quails, flying from the north to the south, were taken in our ship; and sailing at spring time the contrary way, from the south to the north, I observed them on their return, when many of them were taken in the same manner.' This account is confirmed by many others; who aver, that they choose a north wind for these adventures; the south wind being very unfavourable, as it retards their flight by moistening their plumage. They then fly two by two; continuing, when the way lies over land, to go faster by night than by day; and to fly very high, to avoid being surprised or set upon by birds of prey. But it remains a doubt whether quails take such long journeys as Bellonius reports. It is now asserted, that the quail only migrates from one province of a country to another. For instance, in England they fly from the inland counties to those bordering on the sea, and continue there all the winter. If frost or snow drive them out of the stubble fields or marshes, they then retreat to the sea side, shelter themselves among the weeds, and live upon what is thrown up from the sea upon shore. Particularly in Essex, the time of their appearance upon the coasts of that county exactly coincides with their disappearance from the more internal parts of the kingdom; so that what has been said of their long flights is probably not well founded.

These birds are much less prolific than the partridge; seldom laying more than six or seven whitish eggs, marked with ragged rust-coloured spots. But their ardour in courtship yields scarcely to any other bird, as they are fierce and cruel at that season to each other, fighting most desperately, when they are easily taken. Quail-fighting was a favourite amusement among the Athenians: they abstained from the flesh of this bird, deeming it unwholesome, supposing that it fed upon the white hellebore; but they reared great numbers of them for the pleasure of seeing them fight; and staked sums of money, as we do with regard to cocks, upon the success of the combat. Fashion, however, has changed with regard to this bird; we take no pleasure in its courage, but its flesh is considered as a great delicacy.

Quails are easily caught by a call; the fowler, early in the morning, having spread his net, hides himself under it among the corn; he then imitates the voice of the female with his quail-pipe, which the cock hearing, approaches with the utmost assiduity; when he has got under the net, the fowler then discovers himself, and terrifies the quail, who attempting to get away, entangles himself the more in the net, and is taken.

OF BIRDS OF THE PIE KIND IN GENERAL.

In marshalling our army of the feathered creation, we have placed in the van a race of birds long bred to war, and whose passion is slaughter; in the centre we have placed the slow and heavy laden, that are usually brought into the field to be destroyed; we now come to a kind of light infantry, that partake something of the spirit of the two former, and yet belong to neither. In this class we must be content to marshal a numerous, irregular tribe, variously armed, with different pursuits, appetites, and manners; not formidably formed for war, and yet generally delighting in mischief; not slowly and usefully obedient, and yet without any professed enmity to the rest of their fellow tenants of air.

Under this class of birds we may arrange all that noisy, restless, chattering tribe that lies between the hen and the thrush, that from the size of the raven down to that of the woodpecker, flutter round our habitations, and rather with the spirit of pilferers than of robbers, make free with the fruits of human industry.

Of all the other classes this seems to be that which the least contributes to furnish the pleasures, or supply the necessaries of man. The falcon hunts for him; the poultry tribe supplies him with luxurious food; and the little sparrow race delight him with the melody of their warblings. The crane kind make a studied variety in his entertainments; and the class of ducks are not only many of them delicate in their flesh, but useful for their feathers. But in the class of the pie kind there are few, except the pigeon, that are any way useful. They serve rather to teaze man than to assist or amuse him. Like faithless servants, they are fond of his neighbourhood because they mostly live by his labour; but their chief study is what they can plunder in his absence, while their deaths make but little atonement for their depredation.

But though with respect to man this whole class is rather noxious than beneficial; though he may consider them in this light, as false, noisy, troublesome neighbours, yet with respect to each other no class of birds are so ingenious, so active, or so well fitted for society. Could we suppose a kind of morality among birds, we should find that these are by far the most industrious, the most faithful, the most constant, and the most connubial. The rapacious kinds drive out their young before they are fit to struggle with adversity; but the pie kind cherish their young to the last. The poultry class are faithless and promiscuous in their courtship; but these live in pairs, and their attachments are confined to each other. They live in harmony with each other; every species is true to its kind, and transmits an unpolluted race to posterity.

As other kinds build in rocks or upon the ground, the chief place where these build is in trees or bushes; the male takes his share in the labours of building the nest; and relieves his mate in the duties of incubation. Both take this office by turns; and when the young are excluded, both are active in making them an ample provision.

They sometimes live in societies; and in these there are general laws observed, and a kind of republican form of government established among them. They watch not only for the general safety, but for that of every other bird of the grove. How often have we seen a fowler, stealing in upon a flock of ducks or wild geese, disturbed by the alarming note of a crow or a magpie: its single voice gave the whole thoughtless tribe warning, and taught them in good time to look to their safety.

Nor are these birds less remarkable for their instincts than their capacity for instruction. There is an apparent cunning or archness in the look of the whole tribe; and I have seen crows and ravens taught to fetch and carry with the docility of a spaniel. Indeed, it is often an exercise that, without teaching, all this tribe are but too fond of. Every body knows what a passion they have for shining substances, and such toys as some of us put a value upon. A whole family has been alarmed at the loss of a ring; every servant has been accused, and every creature in the house, conscious of their own innocence, suspected each other, when to the utter surprise of all, it has been found in the nest of a tame magpie or a jackdaw, that nobody had ever thought of.

As this class is numerous, their manners are not alike in all. Some, such as the pigeon, are gentle and serviceable to man; others are noxious, capricious, and noisy. In a few general characters they all agree; namely, in having hoarse voices, slight active bodies, and a facility of flight that baffles even the rapacious kinds in the pursuit. I will begin with those birds which most properly may be said to belong to this class, and go on till I finish with the pigeon, a harmless bird that resembles this tribe in little else except their size, and that seems to be the shade uniting the pie and the sparrow kind.

OF THE RAVEN, THE CROW, AND THEIR AFFINITIES.

The raven, the carrion-crow, and the rook, are birds so well known, that a long description would but obscure our ideas of them. The raven is the largest of the three, and distinguished from the rest not only by his size, but by his bill being more hooked than theirs. As for the carrion-crow and the rook, they so strongly resemble each other, both in make and size, that they are not easily distinguished asunder. The chief difference to be found between them lies in the bill of the rook; which, by being frequently thrust into the ground to fetch out grubs and earth worms, is bare of feathers as far as the eyes, and appears of a whitish colour. It differs also in the purple gloss of its feathers, which in the carrion crow are of a blacker hue. Nor is it amiss to make these distinctions, as the rook has but too frequently suffered for its similitude to the carrion crow; and thus a harmless bird, that feeds only upon insects and corn, has been destroyed for another that feeds upon carrion, and is often destructive among young poultry.

The manners of the raven and the carrion crow are very similar; they both feed upon carrion; they fly only in pairs; and will destroy other birds if they can take them by surprise. But it is very different with the rook, the daw, and the Cornish chough, which may be all ranked in this order. They are sociable and harmless; they live only upon insects and grain; and, instead of injuring other birds, they seem centinels for the whole feathered creation. It will be proper, therefore, to describe these two sorts according to their respective appetites, as they have nothing in common but the similitude they bear to each other in their colour and formation.

The raven is a bird found in every region of the world; strong and hardy, he is uninfluenced by the changes of the weather; and when other birds seem benumbed with cold, or pining with famine, the raven is active and healthy, busily employed in prowling for prey, or sporting in the coldest atmosphere. As the heats at the line do not oppress him, so he bears the cold of the polar countries with equal indifference. He is sometimes indeed seen milk white; and this may probably be the effect of the rigorous climates of the north. It is most likely that this change is wrought upon him as upon most other animals in that part of the world, where their robes, particularly in winter, assume the colour of the country where they inhabit.

White ravens are often shown among us, which some say, are rendered thus by art; but this is not the fact. A raven may be converted to almost every purpose to which birds can be used. He may be trained for fowling like a hawk; he may be taught to fetch and carry like a spaniel; and to speak like a parrot; but the most extraordinary of all is, that he can be taught to sing like a man.

When the raven is taken as a domestic, he has many qualities that render him amusing. Busy, inquisitive, and impudent, he goes every where, affronts and drives off the dogs, plays his pranks on the poultry, and is particularly assiduous in cultivating the good will of the cook-maid, who seems to be the favourite of the family. But then, with the amusing qualities of a favourite, he often also has the vices and defects. He is a glutton by nature, and a thief by habit. He does not confine himself to petty depredations on the pantry or the larder; he soars at more magnificent plunder; at spoils that he can neither exhibit nor enjoy; but which, like a miser, he rests satisfied with having the satisfaction of sometimes visiting and contemplating in secret. A piece of money, a tea-spoon, or a ring, are always tempting baits to his avarice; these he will slily seize upon, and, if not watched, will carry to his favourite hole.

In his wild state, the raven is an active and greedy plunderer. Nothing comes amiss to him: whether his prey be living or long dead it is all the same, he falls to with a voracious appetite; and when he has gorged himself, flies to acquaint his fellows that they may participate of the spoil. If the carcase be already in the possession of some more powerful animal, a wolf, a fox, or a dog, the raven sits at a little distance, content to continue a humble spectator till they have done. If in his flights he perceives no hopes of carrion, and his scent is so exquisite that he can smell it at a vast distance, he then contents himself with more unsavory food, fruits, insects, and the accidental dessert of a dunghill.

This bird chiefly builds its nest in trees, and lays five or six eggs of a pale green colour, marked with small brownish spots. They live sometimes in pairs, and sometimes they frequent, in great numbers, the neighbourhood of populous cities, where they are useful in devouring those carcases that would otherwise putrefy and infect the air. They build in high trees or old towers, in the beginning of March with us in England, and sometimes sooner, as the spring is more or less advanced for the season. But it is not always near towns that they fix their retreats: they often build in unfrequented places, and drive all other birds from their vicinity. They will not permit even their young to keep in the same district, but drive them off when they are sufficiently able to shift for themselves. Martin, in his description of the Western Isles, avers, that there are three little islands among the number, which are occupied by a pair of ravens each, that drive off all other birds with great cries and impetuosity.

Notwithstanding the injury these birds do in picking out the eyes of sheep and lambs, when they find them sick and helpless, a vulgar respect is paid them as being the birds that fed the prophet Elijah in the wilderness. This prepossession in favour of the raven is of very ancient date, as the Romans themselves, who thought the bird ominous, paid it, from motives of fear, the most profound veneration. One of these that had been kept in the temple of Castor, as Pliny informs us, flew down into the shop of a tailor, who took much delight in the visits of his new acquaintance. He taught the bird several tricks; but particularly to pronounce the name of the emperor Tiberius, and the whole royal family. The tailor was beginning to grow rich by those who came to see this wonderful raven, till an envious neighbour, displeased at the tailor's success, killed the bird, and deprived the tailor of his future hopes of fortune. The Romans, however, took the poor tailor's part; they punished the man who offered the injury, and gave the raven all the honours of a magnificent interment.

Birds in general live longer than quadrupeds; and the raven is said to be one of the most long-lived of the number: some of them have been known to live near a hundred years. This animal seems possessed of those qualities that generally produce longevity, a good appetite, and great exercise. In clear weather, the ravens fly in pairs to a great height, making a deep loud noise, different from that of their usual croaking.

The carrion crow resembles the raven in its appetites, laying, and manner of bringing up its young. It only differs in being less bold, docile, and favoured by mankind.

The rook leads the way in another, but a more harmless train, that have no carnivorous appetites, but only feed upon insects and corn. The Royston crow is about the size of the two former. The breast, belly, back, and upper part of the neck, being of a pale ash colour; the head and wings glossed over with a fine blue. He is a bird of passage, visiting this kingdom in the beginning of winter, and leaving it in the spring. He breeds, however, in different parts of the British dominions; and his nest is common enough in trees in Ireland. The jackdaw is black, like all the former, but ash-coloured on the breast and belly. He is not above the size of a pigeon. He is docile and loquacious. His head being large for the size of his body, which, as has been remarked, argues him ingenious and crafty. He builds in steeples, old castles, and high rocks, laying five or six eggs in a season. The Cornish chough is like a jackdaw, but bigger, and almost the size of a crow. The feet and legs are long like those of a jackdaw, but of a red colour; and the plumage black all over. It frequents rocks, old castles, and churches by the sea-side, like the daw; and is as noisy. It is only seen along the western coasts of England. These are birds very similar in their manners, feeding on grain and insects, living in society, and often suffering general castigation from the flock for the good of the community.

The rook builds in woods and forests in the neighbourhood of man, and sometimes makes choice of groves in the very midst of cities for the place of its retreat and security. In these it establishes a kind of legal constitution, by which all intruders are excluded from coming to live among them, and none suffered to build but acknowledged natives of the place.

They keep together in pairs; and when the offices of courtship are over, they prepare for making their nests and laying. The old inhabitants of the place are already provided; the nest which served them for years before, with a little trimming and dressing, will serve again; the difficulty of nestling lies only upon the young ones who have no nest, and must therefore get up one as well as they can. But not only the materials are wanting, but also the place in which to fix it. Every part of a tree will not do for this purpose, as some branches may not be sufficiently forked; others may not be sufficiently strong; and others may be too much exposed to the rockings of the wind. The male and female upon this occasion are, for some days, seen examining all the trees of the grove very attentively; and when they have fixed upon a branch that seems fit for their purpose, they continue to sit upon, and observe it sedulously for two or three days longer. The place being determined upon, they begin to gather materials for their nest; such as sticks and fibrous roots, which they dispose in the most substantial manner. But here a new and unexpected obstacle arises. It often happens that the young couple have made choice of a place too near the mansion of an older pair, who do not choose to be incommoded by such troublesome neighbours. A quarrel therefore instantly ensues, in which the old ones are always victorious.

The young couple, thus expelled, are obliged again to go through the fatigues of deliberating, examining, and choosing; and having taken care to keep their due distance, the nest begins again, and their industry deserves commendation. But their alacrity is often too great in the beginning; they soon grow weary of bringing the materials of their nest from distant places; and they perceive that sticks may be provided nearer home, with less honesty, indeed, but some degree of address. Away they go, therefore, to pilfer, as fast as they can; and wherever they see a nest unguarded, they take care to rob it of the choicest sticks of which it is composed. These thefts never go unpunished; for I have seen, says Dr. Goldsmith, eight or ten rooks come upon such occasions, and setting upon the new nest of the young couple all at once, tear it in pieces in a moment.

At length, therefore, the young pair find the necessity of going more regularly and honestly to work. While one flies to fetch the materials, the other sits upon the tree to guard it; and thus in the space of three or four days, with a skirmish now and then between, the pair have fitted up a commodious nest composed of sticks without, and of fibrous roots and long grass within. From the instant the female begins to lay, all hostilities are at an end; not one of the whole grove, that a little before treated her so rudely, will now venture to molest her; so that she brings forth her brood with patient tranquillity. Such is the severity with which even native rooks are treated by each other; but if a foreign rook should attempt to make himself a denizen of their society, he would meet with no favour; the whole grove would at once attack and expel him without mercy.

In some countries these birds are considered as a benefit, in others as a nuisance: their chief food is the worm of the dor-beetle and corn; thus they may be said to do as much service by destroying that noxious insect, as they do injury by consuming the produce of the husbandman's industry.

To this tribe of the crow-kind, some foreign sorts might be added: I will take notice of one, which, from the extraordinary size and fashion of its bill, must not be passed in silence. This is the Calao, or horned Indian raven, which exceeds the common raven in size, and habits of depredation. But he differs from all other birds in the beak, which, by its length and curvature at the end, appears designed for rapine; but then it has a kind of horn standing out from the top, which looks somewhat like a second bill, and gives this bird, otherwise fierce and ugly, a formidable appearance. The horn springs out of the forehead, and grows to the upper part of the bill, being of great bulk; so that near the forehead it is four inches broad, not unlike the horn of the rhinoceros, but more crooked at the tip. The head and beak are out of all proportion, the body being not much larger than that of a hen. Yet even here there are varieties; for in such of those birds as come from different parts of Africa the body is proportionable to the beak; in such as come from the Molucca islands the beak bears no proportion to the body. It lives, like others of its kind, upon carrion, and seldom has a living enemy to cope with.

OF THE MAGPIE AND ITS AFFINITIES.

A GREAT variety of birds may be distributed under this head, so that we must not expect very precise ideas of any. To have a straight strong bill, legs formed for hopping, a body of about the size of a magpie, and party-coloured plumage, are the marks by which I must distinguish this numerous fantastic tribe, that add to the beauty, though not to the harmony of our landscapes. In fact their chattering every where disturbs the melody of the lesser warblers; and their noisy courtship not a little damps the song of the linnet and the nightingale.

But we have very few of this kind in our woods compared to those in the neighbourhood of the line. There they not only paint the scene with the beauty and the variety of their plumage, but stun the ear with vociferation. In those luxurious forests the singing birds are scarcely ever heard, but a hundred varieties of the pie, the jay, the roller, the chatterer, and the toucan, are continually in motion, and with their illusive mockeries disturb or divert the spectator, as he happens to be disposed.

The magpie is the chief of this kind with us, and is too well known to need a description. Were its other accomplishments equal to its beauty, few birds could be put in competition. Its black, its white, its green, and purple, with rich and gilded combination of the glosses on its tail, are as fine as any that adorn the most beautiful of the feathered tribe. But it has too many of the qualities of a beau to depreciate these natural perfections; vain, restless, loud, and quarrelsome, it is an unwelcome intruder every where; and never misses an opportunity, when it finds one, of doing mischief.

The magpie bears a great resemblance to the butcher-bird in its bill, which has a sharp process near the end of the upper chap, as well as in the shortness of its wings, and the form of the tail; each feather shortening from the two middlemost. But it agrees still more in its food, living not only upon worms and insects, but also upon small birds when they can be seized. A wounded lark, or a young chicken separated from the hen, are sure plunder; and the magpie will even sometimes set upon and strike a blackbird.

The same insolence prompts it to teaze the largest animals when its insults can be offered with security. They often are seen perched upon the back of an ox or a sheep, pecking up the insects to be found there, chattering and tormenting the poor animal at the same time, and stretching out their necks for combat, if the beast turns its head backward to reprehend them. They seek out also the nests of birds; and if the parent escapes, the eggs are sure prey; the thrush and the blackbird are but too frequently robbed by this assassin, and this in some measure causes their scarcity.

No food seems to come amiss to this bird; it shares with ravens in their carrion, with rooks in their grain, and with the cuckoo in birds' eggs: but it seems possessed of a providence seldom usual with gluttons; for when it is satisfied for the present, it lays up the remainder of the feast for another occasion. It will even in a tame state hide its food when it has done eating, and after a time return to the secret hoard with renewed appetite and vociferation.

In all its habits it discovers a degree of instinct unusual to other birds. Its nest is not less remarkable for the manner in which it is composed, than for the place the magpie takes to build it in. The nest is usually placed conspicuous enough, either in the middle of some hawthorn bush, or on the top of some high tree. But the place is always difficult of access; for the tree pitched upon usually grows in some thick hedge-row fenced by brambles at the root; sometimes one of the higher bushes is fixed upon for the purpose. When the place is thus chosen as inaccessible as possible to men, the next care is to fence the nest above so as to defend it from all the various enemies of air. The kite, the crow, and the sparrow-hawk, are to be guarded against; as their nests have been sometimes plundered by the magpie, so it is feared they will take the first opportunity to retaliate. To prevent this the magpie's nest is built with surprising labour and ingenuity.

The body of the nest is composed of hawthorn branches, the thorns sticking outward, but well united together by their mutual insertions. Within it is lined with fibrous roots, wool, and long grass, and nicely plastered all round with mud and clay. The body of the nest being thus made firm and commodious, the next work is to make the canopy to defend it above. This is composed of sharp thorns, wove together so as to deny all entrance except at the door, which is just large enough to permit egress and regress to the owners. In this fortress the male and female hatch and bring up their brood with security, sheltered from all attacks but those of the climbing schoolboy, who often finds his torn and bloody hands too dear a price for the eggs or the young ones.

The magpie lays six or seven eggs, of a pale green colour, spotted with brown.

This bird, in its domestic state, preserves its natural character with strict propriety. The same noisy, mischievous habits attend it to the cage that marked it in the woods; and being more cunning, so it is also a more docile bird than any other taken into keeping. Those desirous of teaching it to speak have a foolish custom of cutting its tongue, which only puts the poor animal to pain without improving its speech in the smallest degree. Its speaking is sometimes very distinct; but its sounds are too thin and sharp to be an exact imitation of the human voice, which the hoarse raven and parrot can counterfeit more exactly.

To this tribe we may refer the jay, which is one of the most beautiful of the British birds. The forehead is white streaked with black; the head covered with long feathers, which it can erect into a crest at pleasure; the whole neck, back, breast, and belly, are of faint purple, dashed with grey; the wings are beautifully barred with a lovely blue, black, and white; the tail is black, and the feet a pale brown. Like the magpie, it feeds upon fruits, will kill small birds, and is very docile.

The chatterer also, a native of Germany, may be placed in this rank; and is somewhat less than the former. It is variegated with a beautiful mixture of colours; red, ash-colour, chesnut, and yellow: but what distinguishes it from all other birds, are the horny appendages from the tips of seven of the lesser quill feathers, which stand bare of beards, and have the colour and gloss of red sealing-wax.

The roller is not less beautiful than any of the former. The breast and belly are blue; the head green; and the wings variegated with blue, black, and white. But it may be distinguished from others by the naked tubercles near the eyes, which contribute to increase its beauty.

To this class may be added a numerous list from all the tropical forests of the east and west; where the birds are remarkable for discordant voices and brilliant plumage. I will fix only upon one, which is the most singular of all the feathered creation. This is the toucan, a bird of the pie kind, whose bill is nearly as large as the rest of its whole body.

Of this bird there are four or five varieties. The red-beaked toucan is about the size and shape of a jackdaw, with a large head to support its monstrous bill; this bill, from the angles of the mouth to its point, is six inches and a half; and its breadth, in the thickest part, is a little more than two. Its thickness near the head is one inch and a quarter; and it is a little rounded along the top of the upper chap, the under side being round also; the whole of the bill extremely slight, being only a little thicker than parchment. The upper chap is of a bright yellow, except on each side, which is of a fine scarlet colour; as is also the lower chap, except at the base, which is purple. Between the head and the bill there is a black line of separation all round the base of the bill; in the upper part of which the nostrils are placed, and are almost covered with feathers; which has occasioned some writers to say, that the toucan has no nostrils. Round the eyes, on each side of the head, is a space of bluish skin, void of feathers, above which the head is black, except a white spot on each side joining to the base of the upper chap. The hinder part of the neck, the back, wings, tail, belly, and thighs, are black. The under side of the head, throat, and the beginning of the breast are white. Between the white on the breast, and the black on the belly, is a space of red feathers, in the form of a new moon, with its horns upwards. The legs, feet, and claws, are of an ash-colour; and the toes stand like those of the parrot, two before and two behind.

It is reported by travellers, that this bird, though furnished with so formidable a beak, is harmless and gentle, being so easily made tame, as to sit and hatch its young in houses. It feeds chiefly upon pepper, which it devours greedily, gorging itself so much, that it voids it crude and unconcocted. But this is no objection to the natives from using it again; they even prefer it before that pepper which is fresh gathered; and seem persuaded that the strength and heat of the pepper is qualified by the bird, and that its noxious qualities are exhausted.

Whatever be the truth of this report, nothing is more certain than that the toucan lives only upon a vegetable diet; and in a domestic state, to which it is frequently brought in the warm countries where it is bred, it is seen to prefer such food to all other. Pozzo, who bred one tame, asserts, that it leaped up and down, wagged the tail, and cried with a voice resembling that of a magpie. It fed upon the same things that parrots do; but was most greedy of grapes, which, being plucked off one by one, and thrown into the air, it would most dexterously catch before they fell to the ground. Its bill, he adds, was hollow, and upon that account very light, so that it had but little strength in so apparently formidable a weapon; nor could it peck or strike smartly therewith, but its tongue seemed to assist the efforts of this unwieldy machine: it was long, thin, and flat, not unlike one of the feathers on the neck of a dunghill cock; this it moved up and down, and often extended five or six inches from the bill. It was of a flesh colour, and very remarkably fringed on each side with very small filaments, exactly resembling a feather.

Probably this long tongue has greater strength than the thin hollow beak that contains it. It is likely that the beak is only a kind of sheath for this instrument, used by the toucan, not only in making itself a nest, but in obtaining its provision. Nothing is more certain than that this bird builds its nest in holes of trees, which have been previously scooped out for this purpose; and it is not very likely that so feeble a bill could be very serviceable in working upon such hard materials. Indeed, there is no bird that secures its young better from external injury than the toucan. It has not only birds, men, and serpents to guard against, but a numerous tribe of monkeys, still more preying, mischievous, and hungry than all the rest. The toucan, however, scoops out its nest in the hollow of some trees, leaving only a hole large enough to go in and out at. There it sits, with its great beak, guarding the entrance, and if the monkey ventures to offer a visit of curiosity, the toucan gives him such a welcome, that he soon thinks proper to depart, and is glad to escape with safety.

This bird is only found in the warm climates of South America, where it is in great request, both for the delicacy of its flesh, which is tender and nourishing, and the beauty of its plumage, particularly the feathers of the breast. The skin of this part the Indians pluck off, and when dry, glue to their cheeks; and this they consider as an irresistible addition to their beauty.

THE WOODPECKER AND ITS AFFINITIES.

The numerous tribes of Woodpeckers form a class easily distinguished from all others, both for their formation, their method of procuring food, and their providing a place of safety for their young. No class of birds seems more immediately formed for the method of life they pursue, being fitted by nature, at all points, for the peculiarity of their condition. They live chiefly upon the insects contained in the body of trees; and for this purpose are furnished with a straight, hard, strong, angular, and sharp bill, made for piercing and boring. They have a tongue of a very great length; round, ending in a sharp, stiff, bony thorn, dentated on each side, to strike ants and insects when dislodged from their cells. Their legs are short and strong, for the purposes of climbing. Their toes stand two forward and two backward; which is particularly serviceable in holding by the branches of trees. They have hard stiff tails to lean upon when climbing. They feed only upon insects, and want that intestine, which naturalists call the *cœcum;* a circumstance peculiar to this tribe only.

Of this bird there are many kinds, and many varieties in each kind. They form large colonies in the forests of every part of the world. They differ in size, colour, and appearance; but agree in the marks above-mentioned, or in those habits which result from so peculiar a conformation. Instead, therefore, of descending into a minute discrimination of every species, let us take one for a pattern, to which all the rest will be found to bear the strongest affinity. Words can but feebly describe the plumage of a bird, but it is the province of history to enter into a detail of every animal's pursuits and occupations.

The green woodspite, or woodpecker, is called the *rain-fowl* in some parts of the country; because when it makes a greater noise than ordinary, it is supposed to foretel rain. It is about the size of a jay; the throat, breast, and belly are of a pale greenish colour; and the back, neck, and covert feathers of the wings are green. But the tongue of this little animal makes its most distinguished characteristic, as it serves for its support and defence. As was said above, the woodpecker feeds upon insects; and particularly on those which are lodged in the body of hollow or of rotting trees. The tongue is its instrument for killing and procuring this food; which cannot be found in great plenty. This is round, ending in a stiff, sharp, bony tip, dentated on both sides, like the beard of an arrow; and this it can dart out three or four inches from the bill, and draw in again at pleasure. Its prey is thus transfixed, and drawn into the bill, which, when swallowed, the dart is again launched at fresh game. Nothing has employed the attention of the curious in this part of anatomy, more than the contrivance by which the tongue of this bird performs its functions with such great celerity. The tongue is drawn back into the bill by the help of two small round cartilages, fastened into the fore-mentioned bony tip, and running along the length of the tongue. These cartilages, from the root of the tongue, take a circuit beyond the ears; and being reflected backwards to the crown of the head, make a large bow. The muscular spongy flesh of the tongue incloses these cartilages, like a sheath; and is so made, that it may be extended or contracted like a worm. The cartilages indeed have muscles accompanying them along their whole length backwards. But there is still another contrivance; for there is a broad muscle joining the cartilages to the bones of the skull, which, by contracting or dilating, forces the cartilages forward through the tongue, and then forces the tongue and all through the bill, to be employed for the animal's preservation in piercing its prey.

Such is the instrument with which this bird is provided; and this the manner in which it is employed. When a woodpecker finds a rotten hollow tree, where there are worms, ants' eggs, or insects, it prepares for its operations. Resting by its strong claws, and leaning on the thick feathers of its tail, it begins to bore with its sharp strong beak, until it discloses the whole internal habitation. Upon this, either through pleasure at the sight of its prey, or with a desire to alarm the insect colony, it sends forth a loud cry, which throws terror and confusion into the whole insect tribe.—They creep hither and thither, seeking for safety; while the bird feasts upon them at leisure, darting its tongue with certainty, and devouring the whole brood.

Yet the woodpecker does not confine its depredations solely to trees, but sometimes lights upon the ground, to try its fortune at an ant-hill. It is not so secure of prey there as in the former case, although the numbers are much greater. They lie generally too deep for the bird to come at them; and it is obliged to make up by stratagem the defects of power. The woodpecker first goes to their hills, which it pecks, in order to call them abroad; it then thrusts out its long red tongue, which being like a worm, and resembling their usual prey, the ants come out to settle upon it in great numbers; and the bird watching its opportunity, withdraws its tongue at a jerk, and devours the devourers. This stratagem it continues till it has alarmed their fears; or till it is satisfied.

As the woodpecker is obliged to make holes in trees to procure food, so it is also to make cavities still larger to form its nest and to lay in. This is performed, as usual, with the bill. Those that are curious, may often hear the noise of the bill making its way in large woods and forests. The woodpecker chooses for this purpose, trees that are decayed, or wood that is soft, like beech, elm, and poplar. In these it can make holes as exactly round as a mathematician could with compasses. One of these holes the bird generally chooses for its own use, to nestle and bring up its young in; but as they are easily made, it is delicate in its choice, and often makes twenty before one is found fit to give entire satisfaction. Of those which it has made and deserted, other birds, not so good borers, and less delicate in their choice, take possession. The jay and the starling lay their eggs in these holes; and bats are now and then found in peaceable possession. Boys sometimes have thrust in their hands with certain hopes of plucking out a bird's egg; but to their great mortification, have had their fingers bitten by a bat at the bottom.

The woodpecker takes no care to line its nest with feathers or straw; its eggs are deposited in the hole, without any thing to keep them warm, except the heat of the parent's body. Their number is generally five or six; always white, oblong, and of a middle size. When the young are excluded, and before they leave the nest, they are adorned with a scarlet plumage under the throat.

In our climate, this bird is contented with a wainscot habitation for its young; but in Guinea and Brazil, they take a different method to protect and hatch their progeny. A traveller who walks into the forests of those countries, among the first strange objects that excite curiosity, is struck with the multitude of birds' nests hanging at the extremity of almost every branch. Many other sorts of birds build in this manner, but the chief of them are of the woodpecker kind; and there is not, in the whole history of Nature, a more singular instance of the sagacity of those little animals in protecting themselves against such enemies as they have most occasion to fear. In cultivated countries, a great part of the caution of the feathered tribe is to hide or defend their nests from the invasions of man; as he is their most dreaded enemy. But in the depths of those remote and solitary forests, where man is seldom seen, the little bird has nothing to apprehend from man. The parent is careless how much the nest is exposed to general notice; satisfied if it be out of the reach of those rapacious creatures that live by robbery and surprise. If the monkey or the snake can be guarded against, the bird has no other enemies to fear: for this purpose its nest is built upon the depending points of the most outward branches of a tall tree, such as the banana or the plantain. On one of those immense trees, is seen the most various, and the most inimical assemblage of creatures that can be imagined. The top is inhabited by monkeys of some particular tribe, that drive off all others; lower down twine about the great trunk numbers of the larger snakes, patiently waiting till some unwary animal comes within the sphere of their activity, and at the edges of the tree hang these artificial nests, in great abundance, inhabited by birds of the most delightful plumage.

When the time of incubation approaches, they fly busily about, in quest of a kind of moss, called by the English inhabitants of those countries *old man's beard.* It is a fibrous substance, and not very unlike hair, which bears being moulded into any form, and may be glued together. This the little woodpecker, called by the natives of Brazil, the *goiratemga,* first glues by some viscous substance, gathered in the forest, to the extremest branch of a tree; then building downward, and still adding fresh materials to those already procured, a nest is formed, that depends, like a pouch, from the point of the branch: the hole to enter at, is on the side; and the interior parts are lined with the finer fibres of the same substance.

Such is the general contrivance of these hanging nests; which are made, by some other birds, with still superior art. A little bird of the grosbeak kind, in the Philippine islands, makes its nest in such a manner that there is no opening but from the bottom. At the bottom the bird enters, and goes up through a funnel like a chimney, till it comes to the real door of the nest, which lies on one side, and only opens into this funnel.

Some birds glue their nest to the leaf of the banana-tree, which makes two sides of their little habitation; while the other two are artificially composed by their own industry. But these, and all of the kind, are built with the same precautions to guard the young against the depredations of monkeys and serpents, which abound in every tree. The nest hangs there, before the spoilers, a tempting object, which they can only gaze upon, while the bird flies in and out, without danger or molestation, from so formidable a vicinity.

OF THE BIRD OF PARADISE AND ITS VARIETIES.

Few birds have more deceived and puzzled the learned than this. Some have described it as an inhabitant of the air, living only upon the dew of heaven, and never resting below; others have acquiesced in the latter part of its history, but have given it flying insects to feed on. Some have asserted that it was without feet, and others have ranked it among the birds of prey.

The great beauty of this bird's plumage, and the deformity of its legs, seem to have given rise to most of these erroneous reports. The native savages of the Molucca islands, of which it is an inhabitant, were little studious of natural history; and perceiving the inclination the Europeans had for this beautiful bird, carefully cut off its legs before they brought it to market; thus concealing its greatest deformity, they considered themselves entitled to rise in their demands when they offered it for sale. One deceit led on to another; the buyer, finding the birds without legs, naturally enquired after them; and the seller, as naturally, began to assert that it had none. Thus far the European was imposed upon by others; in all the rest he imposed upon himself. Seeing so beautiful a bird without legs, he concluded that it could live only in air, where legs were unnecessary. The extraordinary splendour of its plumage assisted this deception; and as it had heavenly beauty, so it was asserted to have a heavenly residence. From thence its name, and all the false reports that have been propagated concerning it.

But time has discovered that this bird not only has legs, but very large strong ones for its size. Credulity, when undeceived, runs into the opposite extreme; and soon after this harmless bird was branded with the character of being rapacious, of destroying all those of smaller size, and, from the amazing rapidity of its flight, as qualified peculiarly for extensive rapine. The real history of this pretty animal is at present tolerably well known; and it is found to be as harmless as it is beautiful.

There are two kinds of the bird of paradise; one about the size of a pigeon, which is the more common; the other not much larger than a lark, which has been described more imperfectly. They are both distinguished from others, not only by the superior vivacity of their tints, but by the feathers of the tail, there being two long slender filaments growing from the upper part of the rump, which are longer than the bird's body, and bearded only at the end. By this mark the bird of paradise may be easily known, but still more so by its gaudy livery, which being so very brilliant demands to be minutely described.

The bird appears to the eye as large as a pigeon, though in reality the body is not much greater than that of a thrush. The tail, which is about six inches, is as long as the body; the wings are large, compared with the bird's other dimensions. The head, the throat, and the neck are of a pale gold colour. The base of the bill is surrounded by black feathers, as also the side of the head and throat, as soft as velvet, and changeable like those on the neck of a mallard. The hinder part of the head is of a shining green, mixed with gold. The body and wings are chiefly covered with beautiful brown, purple, and gold feathers. The uppermost part of the tail feathers are of a pale yellow, and those under them white and longer than the former; for which reason the hinder part of the tail appears to be all white. But what chiefly excites curiosity are, the two long naked feathers above mentioned, which spring from the upper part of the rump above the tail, and which are usually about three feet long. These are bearded only at the beginning and the end; the whole shaft, for above two feet nine inches, being of a deep black, while the feathered extremity is of a changeable colour, like the mallard's neck.

This bird, which for beauty exceeds all others of the pie kind, is a native of the Molucca islands, but found in greater numbers in that of Aro. There, in the spicy woods of the country, do these beautiful creatures fly in large flocks; so that the groves which produce the richest spices produce the finest birds also. The inhabitants themselves are not insensible of the pleasure these afford, and give them the name of God's birds, as being superior to all others that he has made. They live in large flocks, and at night generally perch upon the same tree. They are called by some, the *swallows of Ternate*, from their rapid flight, and from their being continually on the wing in pursuit of insects, their usual prey.

As the country where they are bred has its tempestuous seasons, when rains and thunders continually disturb the atmosphere, these birds are then but seldom seen. It is thought that they then fly to other countries where their food appears in greater abundance; for, like swallows, they have their stated times of return. In the beginning of August they are seen in great numbers flying together; and, as the inhabitants would have us believe, following their king, who is distinguished from the rest by the lustre of his plumage, and that respect and veneration which is paid him. In the evening they perch upon the highest trees of the forest, particularly one which bears a red berry, upon which they sometimes feed when other food fails. In what manner they breed, or what may be the number of their young, yet remains unknown.

The natives, who make a trade of killing and selling these birds to the Europeans, generally conceal themselves in the trees where they resort, and having covered themselves up from sight in a bower made of the branches, they shoot at the birds with reedy arrows; and, as they assert, if they happen to kill the king, they then have a good chance for killing the greater part of the flock. The chief mark by which they know the king is by the ends of the feathers in his tail, which have eyes like those of a peacock. When they have taken a number of these birds, their usual method is to gut them, and cut off their legs; they then run a hot iron into the body, which dries up the internal moisture; and filling the cavity with salts and spices, they sell them to the Europeans for a trifle.

THE CUCKOO AND ITS VARIETIES.

From a bird of which many fables have been reported, we pass to another that has not given less scope to fabulous invention. The note of the cuckoo is known to all the world; the history and nature of the bird itself still remains in obscurity. That it devours its parent, that it changes its nature with the season, and becomes a sparrow-hawk, were fables invented of this bird, and are now sufficiently refuted. But where it resides in winter, or how it provides for its supply during that season, still continues undiscovered.

This singular bird, which is somewhat less than a pigeon, shaped like a magpie, and of a greyish colour, is distinguished from all other birds by its round prominent nostrils. Having disappeared all the winter, it discovers itself in our country early in the spring, by its well known call. Its note is heard earlier or later as the season seems to be more or less forward, and the weather more or less inviting. From the cheerful voice of this bird the farmer may be instructed in the real advancement of the year. The fallibility of human calendars is but too well known; but from this bird's note the husbandman may be taught when to sow his most useful seeds, and do such work as depends upon a certain temperature of the air. These feathered guides come to us heaven-taught, and point out the true commencement of the season.

The cuckoo, that was silent some time after its appearance, begins at first feebly, and at distant intervals, to give its call, which, as summer advances, improves in its frequency and loudness. This is an invitation to courtship, and used only by the male, who sits generally perched upon some dead tree, or bare bough, and repeats his song, which he loses as soon as the genial season is over. His note is pleasant, though uniform; and, from an association of ideas, seldom occurs to the memory without reminding us of the sweets of summer. Custom too has fixed a more ludicrous association to this note. This reproach seems to arise from this bird's making use of the bed or nest of another to deposit its own brood in.

However, nothing is more certain than that the female makes no nest of her own. She repairs to the nest of some other bird, generally the water-wagtail, or the hedge-sparrow, and having devoured the eggs of the owner, lays her own in their place. She usually lays but one, which is speckled, and of the size of a blackbird's. This the fond foolish bird hatches with assiduity, and when excluded, finds no difference in the great ill-looking changeling from her own. To supply this voracious creature the credulous nurse toils with unusual labour, no way sensible that she is feeding up an enemy to her race, and one of the most destructive robbers of her future progeny.

It was once doubted whether these birds were carnivorous; but Reaumur was at the pains of breeding up several, and found that they would not feed upon bread and corn; but flesh and insects were their favourite nourishment. He found it a difficult task to make them peck; for he was obliged to feed them a full month after they were grown as big as the mother. Insects, however, seemed to be their peculiar food when young; for they devoured flesh by a kind of constraint; as it was always put into their mouths; but meal-worm insects they flew to, and swallowed of their own accord most greedily. Indeed their gluttony is not to be wondered at, when we consider the capacity of their stomach, which is enormous, and reaches from the breast bone to the vent. It is partly membranous, partly muscular, and of a prodigious capacity; yet still they are not to be supposed as birds of prey, for they have neither strength nor courage. On the contrary, they are naturally weak and fearful, as appears by their flying from small birds which pursue them. The young birds are brown mixed with black; and in that state they have been described by some authors as old ones.

The cuckoo, when fledged and fitted for flight, follows its supposed parent but for a little time; its appetites for insect food increasing, as it finds no great chance for a supply in imitating its little conductor, it parts good friends, the step-child seldom offering any violence to its nurse. Nevertheless, all the little birds of the grove seem to consider the young cuckoo as an enemy, and revenge the cause of their kind by repeated insults. They pursue it wherever it flies, and oblige it to take shelter in the thickest branches of a neighbouring tree. All the smaller birds form the train of its pursuers; but the wry-neck, in particular, is the most active in the chase; and from thence it has been called by many the cuckoo's attendant and provider. But it is far from following with a friendly intention; it only pursues as an insulter, or a spy, to warn its little companions of the cuckoo's depredations.

Such are the manners of this bird while it continues to reside, or to be seen amongst us. But early, at the approach of winter, it disappears, and its passage can be traced to no other country. Some suppose that it lies hid in hollow trees; and others that it passes into warmer climates. Which of these opinions is true is uncertain, as there are no facts related on either side that can be totally relied on.

The most probable opinion on this subject is, that as quails and woodcocks shift their habitations in winter, so also does the cuckoo; but to what country it retires, or whether it has ever been seen on its journey, are questions we are incapable of resolving.

Of this bird there are many kinds in various parts of the world, not only differing in their colours, but their size. Brisson makes not less than twenty-eight sorts of them; but what analogy they bear to the English cuckoo, I will not take upon me to determine. He talks of one, particularly of Brazil, as making a most horrible noise in the forests; which, as it should seem, must be a very different note from that by which our bird is distinguished at home.

OF THE PARROT AND ITS AFFINITIES.

The Parrot is the best known among us of all foreign birds, as it unites the greatest beauty with the greatest docility. Its voice also is more like a man's than that of any other; the raven is too hoarse, and the jay and magpie too shrill, to resemble the truth; the parrot's note is of the true pitch, and capable of a number of modulations that even some of our orators might wish in vain to imitate.

The ease with which this bird is taught to speak, and the great number of words which it is capable of repeating, are no less surprising. We are assured that one of these was taught to repeat a whole sonnet from Petrarch; and that I may not be wanting in my instance, I have seen a parrot belonging to a distiller, who had suffered pretty largely in his circumstances from an informer who lived opposite to him, very ridiculously employed. This bird was taught to pronounce the ninth commandment, *Thou shalt not bear false witness against thy neighbour*, with a very clear, loud, articulate voice. The bird was placed in its cage over against the informer's house, and delighted the whole neighbourhood with its persevering exhortations.

Willoughby tells a story of a parrot, which is not so dull as those usually brought up when the bird's facility of talking happens to be the subject. 'A parrot belonging to King Henry the Seventh, who then resided at Westminster, in his palace by the river Thames, had learned to talk many words from the passengers as they happened to take water. One day, sporting on its perch, the poor bird fell into the water, at the same time crying out as loud as he could, *A boat! twenty pounds for a boat!* A waterman, who happened to be near, hearing the cry, made to the place where the parrot was floating, and taking him up restored him to the king. As it seems the bird was a favourite, the man insisted that he ought to have a reward rather equal to his services than his trouble; and, as the parrot had cried twenty pounds, he said the king was bound in honour to grant it. The king at last agreed to leave it to the parrot's own determination, which the bird hearing, cried out, *give the knave a groat.*'

The parrot, which is so common as a foreign bird with us, is equally so as an indigenous bird in the climates where it is produced. The forests swarm with them; and the rook is not better known with us than the parrot in almost every part of the East and West Indies. It is in vain that our naturalists have attempted to arrange the various species of this bird; new varieties daily offer to puzzle the system-maker, or to demonstrate the narrowness of his catalogues. Linnæus makes the number of its varieties amount to forty-seven; while Brisson doubles the number, and extends his catalogue to ninety-five. Perhaps even this list might be increased, were every accidental change of colour to be considered as constituting a new species. But natural history gains little by these discoveries; and as its dominions are extended it becomes more barren. It is asserted, by sensible travellers, that the natives of Brazil can change the colour of a parrot's plumage by art. If this be true, and I am apt to believe the information, they can make new species at pleasure, and thus cut out endless work for our nomenclators at home.

Those who usually bring these birds over, are content to make three or four distinctions, to which they give names; and with these distinctions I shall content myself also. The large kind, which are of the size of a raven, are called *maccaws;* the next size are simply called *parrots;* those which are entirely white, are called *lories;* and the lesser size of all are called *parakeets.* The difference between even these is rather in size than any other peculiar conformation, as they are all formed alike, having toes, two before and two behind, for climbing and holding; strong hooked bills for breaking open nuts, and other hard substances, on which they feed; and loud harsh voices, by which they fill their native woods with clamour.

But there are further peculiarities in their conformation: and first, their toes are contrived in a singular manner, which appears when they walk or climb, and when they are eating. For the first purpose they stretch two of their toes forward, and two backward; but when they take their meat, and bring it to their mouths with their foot, they dexterously and nimbly turn the greater hind toe forward, so as to take a firmer grasp of the nut, or the fruit they are going to feed on, standing all the while upon the other leg. Nor even do they present their food in the usual manner; for other animals turn their meat inwards to the mouth; but these, in a seemingly awkward position, turn their meat outwards, and thus hold the hardest nuts, as if in one hand, till with their bills they break the shell, and extract the kernel.

The bill is fashioned with still greater peculiarities; for the upper chap, as well as the lower, are both moveable. In most other birds the upper chap is connected, and makes but one piece with the skull; but in these, and in one or two species of the feathered tribe more, the upper chap is connected to the bone of the head by a strong membrane, placed on each side, that lifts and depresses it at pleasure. By this contrivance they can open their bills the wider; which is not a little useful, as the upper chap is so hooked and so over-hanging, that, if the lower chap only had motion, they could scarcely gape sufficiently to take any thing in for their nourishment.

Such are the uses of the beak and the toes, when used separately, but they are often employed both together when the bird is exercised in climbing. As these birds cannot readily hop from bough to bough, their legs not being adapted for that purpose, they use both the beak and the feet; first catching hold with the beak, as if with a hook, and drawing up the legs and fastening them, then advancing the head and beak again, and so putting forward the body and the feet alternately, till they attain the height they aspire to.

The tongue of this bird somewhat resembles that of a man; for which reason some pretend that it is well qualified to imitate the human speech; but the organs by which these sounds are articulated, lie farther down in the throat, being performed by the great motion which the *os hyoides* has in these birds above others.

The parrot, though common enough in Europe, will not, however, breed here. The climate is too cold for its warm constitution; and though it bears our winter when arrived at maturity, yet it always seems sensible of its rigour, and loses both its spirit and appetite during the colder parts of the season. It then becomes torpid and inactive, and seems quite changed from that bustling loquacious animal which it appeared in its native forest, where it is almost ever upon the wing. Notwithstanding, the parrot lives even with us a considerable time, if it be properly attended to; and, indeed, it must be owned, that it employs but too great a part of some people's attention.

The sagacity and docility of the bird may plead as the best excuse for those who spend whole hours in teaching their parrots to speak; and, indeed, the bird, on those occasions, seems the wisest animal of the two. It at first resists all instruction; but seems to be won by perseverance, makes a few attempts to imitate the first sounds, and when it has got one word distinct, all the succeeding come with greater facility. The bird generally learns most in those families where the master or mistress have the least to do; and becomes more expert, in proportion as its instructors are idly assiduous. 'In going through the towns of France some time since,' says Dr. Goldsmith, 'I could not help observing how much plainer their parrots spoke than ours, and how very distinctly I understood their parrots speak French, when I could not understand our own, though they spoke my native language. I was at first for ascribing it to the different qualities of the two languages, and was for entering into an elaborate discussion on the vowels and consonants; but a friend that was with me solved the difficulty at once, by assuring me that the French women scarce did any thing else the whole day than sit and instruct their feathered pupils; and that the birds were thus distinct in their lessons in consequence of continual schooling.'

The parrots of France are certainly very expert, but nothing to those of the Brazils, where the education of a parrot is considered as a serious affair. The history of Prince Maurice's parrot, given us by Mr. Locke, is too well known to be repeated here; but Clusius assures us that the parrots of that country are the most sensible and cunning of all animals not endued with reason. The great parrot, called the *aicurous*, the head of which is adorned with yellow, red, and violet, the body green, the end of the wings red, the feathers of the tail long and yellow; this bird, he asserts, which is seldom brought into Europe, is a prodigy of understanding. 'A certain Brazilian woman, that lived in a village two miles distant from the island on which we resided, had a parrot of this kind which was the wonder of the place. It seemed endued with such understanding, as to discern and comprehend whatever she said to it. As we sometimes used to pass by that woman's house, she used to call upon us to stop, promising, if we gave her a comb, or a looking-glass, that she would make her parrot sing and dance to entertain us. If we agreed to her request, as soon as she had pronounced some words to the bird, it began not only to leap and skip on the perch on which it stood, but also to talk and to whistle, and imitate the shoutings and exclamations of the Brazilians when they prepare for battle. In brief, when it came into the woman's head to bid it sing, it sang; to dance, it danced. But if, contrary to our promise, we refused to give the woman the little present agreed on, the parrot seemed to sympathise in her resentment, and was silent and immoveable; neither could we, by any means, provoke it to move either foot or tongue.'

This sagacity, which parrots show in a domestic state, seems also natural to them in their native residence among the woods. They live together in flocks, and mutually assist each other against other animals, either by their courage or their notes of warning. They generally breed in hollow trees, where they make a round hole, and do not line their nests within. If they find any part of a tree beginning to rot from the breaking off of a branch, or any such accident, this they take care to scoop, and to make the hole sufficiently wide and convenient; but it sometimes happens that they are content with the hole which a woodpecker has wrought out with greater ease before them; where they prepare to hatch and bring up their young.

They lay two or three eggs; and probably the smaller kind may lay more; for it is a rule that universally holds through nature, that the smallest animals are always the most prolific; for being, from their natural weakness, more subject to devastation, nature finds it necessary to replenish their species by superior fecundity. In general the number of their eggs is stinted to two, like those of the pigeon, and they are about the same size. They are always marked with little specks, like those of a partridge; and some travellers assure us, that they are always found in the trunks of the tallest, straightest, and largest trees. The natives of these countries, who have little else to do, are assiduous in finding the places where the parrot nestles, and generally come with joy to inform the Europeans, if there be any, of the discovery. As those birds have the greatest docility that are taken young, such a nest is considered as worth taking some trouble to be possessed of; and for this purpose the usual method of coming at the young is by cutting down the tree. In the fall of the tree it often happens that the young parrots are killed; but if one of them survives the shock, it is considered as a sufficient recompence.

Such is the avidity with which these birds are sought when young; for it is known they always speak best when their ear has not been anticipated by the harsh notes of the wild ones. But as the natives are not able upon all occasions to supply the demand for young ones they are contented to take the old; and for that purpose shoot them in the woods with heavy arrows, headed with cotton, which knock down the bird without killing it. The parrots thus stunned are carried home: some die, but others recover, and by kind usage and plentiful food, become talkative and noisy.

But it is not for the sake of their conversation alone that the parrot is sought after among the savages; for though some of them are but tough and ill-tasted, yet there are other sorts, particularly of the small parakeet tribe, that are delicate food. In general it obtains, that whatever fruit or grain these birds mostly feed upon, their flesh partakes of the flavour, and becomes well or ill-tasted, according to the quality of that particular diet. When the guava is ripe, they are at that season fat and tender; if they feed upon the seed of the acajou their flesh contracts an agreeable flavour of garlic; if they feed upon seed of the spicy trees, their flesh then tastes of cloves and cinnamon; while, on the contrary, it is insupportably bitter if the berries they feed on are of that quality. The seed of the cotton-tree intoxicates them in the same manner that wine does man; and even wine itself is drunk by parrots, as Aristotle assures us, by which they are rendered more talkative and amusing. But of all food they are fondest of the bastard saffron; which though strongly purgative to man, agrees with their constitution, and fattens them in a short time.

Of the parakeet kind in Brazil, Labat assures us, that they are the most beautiful in their plumage, and the most talkative birds in nature. They are very tame, and appear fond of mankind; they seem pleased with holding parley with him; they never have done; but while he continues to talk, answer him, and appear resolved to have the last word; but they are possessed of another quality, which is sufficient to put an end to this association: their flesh is the most delicate imaginable, and highly esteemed by those who are fonder of indulging their appetites than their ears. The fowler walks into the woods, where they keep in abundance; but as they are green, and exactly the colour of the leaves among which they sit, he only hears their prattle; without being able to see a single bird, he looks round him, sensible that his game is within gun-shot in abundance, but is mortified that it is impossible to see them. Unfortunately for these little animals, they are restless and ever on the wing, so that in flying from one tree to another he has but too frequent opportunites of destroying them; for as soon as they have stripped the tree on which they sat of all its berries, some one of them flies off to another; and if that be found fit for the purpose, it gives a loud call, which the rest resort to. That is the opportunity the fowler has been waiting for; he fires among the flock, while they are yet on the wing; and seldom fails of bringing down a part of them. But it is singular to see them when they find their companions fallen. They set up a loud outcry, as if they were chiding their destroyer, and do not cease till they see him preparing for a second charge.

But though there are so many motives for destroying these beautiful birds, they are in great plenty; and in some countries on the coast of Guinea they are considered by the negroes as their greatest tormentors. The flocks of parrots persecute them with their unceasing screaming, and devour whatever fruits they attempt to produce by art in their little gardens. In other places they are not so destructive, but sufficiently common; and indeed there is scarcely a country of the tropical climates that has not many of the common kind, as well as some peculiarly its own. Travellers have counted more than a hundred different kinds on the continent of Africa only; there is one country in particular, north of the Cape of Good Hope, which takes its name from the multitude of parrots which are seen in its woods. There are white parrots seen in the burning regions of Æthiopia; in the East Indies they are of the largest size; in South America they are docile and talkative; in all the islands of the Pacific Sea and the Indian Ocean they swarm in great variety and abundance, and add to the splendour of those woods which nature has dressed in eternal green.

So generally are these birds known at present, and so great is their variety, that nothing seems more extraordinary than that there was but one sort of them known among the ancients, and that at a time when they pretended to be masters of the world. If nothing else could serve to show the vanity of a Roman's boast, the parrot tribe might be an instance, of which there are a hundred kinds now known; not one of which naturally breeds in the countries that acknowledged the Roman power. The green parakeet, with a red neck, was the first of this kind that was brought into Europe, and the only one that was known to the ancients, from the time of Alexander the Great to the age of Nero: this was brought from India; and when afterwards the Romans began to rummage through their dominions for new luxuries, they at last found out others in Gaganda, an island of Æthiopia, which they considered as an extraordinary discovery.

Parrots have usually the same disorders with other birds; and they have one or two peculiar to their kind. They are sometimes struck by a kind of apoplectic blow, by which they fall from their perches, and for a while seem ready to expire. The other is the growing of the beak, which becomes so very much hooked as to deprive them of the power of eating. These infirmities, however, do not hinder them from being long-lived; for a parrot, well kept, will live five or six and twenty years.

THE PIGEON, AND ITS VARIETIES.

This is one of the birds which, from its great fecundity, we have in some measure reclaimed from a state of nature, and taught to live in habits of dependence. Indeed its fecundity seems to be increased by human cultivation; since those pigeons that live in a wild state, in the woods, are by no means so fruitful as those in our pigeon-houses nearer home. The power of increase in most birds depends upon the quantity of their food; and it is seen, in more than one instance, that man, by supplying food in plenty, and allowing the animal at the same time a proper share of freedom, has brought some of those kinds which are known to lay but once a year, to become much more prolific.

The tame pigeon, and all its beautiful varieties, derive their origin from one species, the stock-dove only; the English name, implying its being the stock or stem from whence the other domestic kinds have been propagated. This bird, in its natural state, is of a deep bluish ash-colour; the breast dashed with a fine changeable green and purple; its wings are marked with two black bars; the back white, and the tail barred near the end with black. These are the colours of the pigeon in a state of nature; and from these simple tints has man by art propagated a variety that words cannot describe, nor even fancy suggest. However, nature still perseveres in the great outline; and though the form, colour, and even her fecundity of these birds may be altered by art, yet their natural manners and inclinations continue still the same.

The stock-dove in its native woods differs from the ring-dove, a bird that has never been reclaimed, by its breeding in the holes of rocks and the hollows of trees. All other birds of the pigeon-kind build, like rooks, in the topmost branches of the forest, and choose their habitation as remote as possible from man. But this species soon takes to build in artificial cavities; and from the temptation of a ready provision and numerous society, easily submits to the tyranny of man. But still it preserves its native colour for several generations, and becomes more variegated only in proportion as it removes from the original simplicity of its colouring in the woods.

The dove-house pigeon breeds every month; but then it is necessary to supply it with food when the weather is severe, or the fields covered with snow. Upon other occasions it may be left to provide for itself, and it generally repays the owner for his protection. The pigeon lays two white eggs, which most usually produce young ones of different sexes. The egg is usually deposited in the afternoon. The eggs thus laid, the female, in the space of fifteen days, not including the three days during which she is employed in laying, continues to hatch, relieved at intervals by the male. The turns are usually regulated with exactness. From three or four o'clock in the evening till nine the next day, the female continues to sit; she is then relieved by the male, who takes his place from ten till three, while his mate is feeding abroad. In this manner they sit alternately till the young are excluded. If during this term the female delays to return at the expected time, the male follows, and drives her to the nest; and should he in his turn be dilatory, she retaliates with equal severity.

The young ones, when hatched, require no food for the three first days, only wanting to be kept warm, which is an employment the female takes upon herself. During this period she never stirs out, except for a few minutes to take a little food. From this they are fed for eight or ten days with corn or grain of different kinds, which the old ones gather in the fields, and keep treasured up in their crops, from whence they throw it up again into the mouths of their young ones who greedily demand it.

As this method of feeding the young from the crop is different in birds of the pigeon-kind from all others, it demands a more detailed explanation. Of all birds, for its size, the pigeon has the largest crop, which is also made in a manner peculiar to the kind. If a person blow air into the wind-pipe of this pigeon, it will distend the crop or gullet to a prodigious size. This is the more extraordinary, as there seems to be no communication whatever between these two receptacles; for the conduit by which we breathe leads to a different receptacle from that where we put our food. By what apertures the air blown into the lungs of the pigeon makes its way into the crop, is unknown; but nothing is more certain than that these birds have a power of filling the crop with air; and some of them, which are called *croppers*, distend it so much, that the bird's breast seems bigger than its body. The peculiar mechanism of this part is not well known; but the necessity for it in these animals is obvious. The pigeon lives entirely upon grain and water: these are mixed together in the crop; and in the ordinary way are digested in proportion as the bird lays in its provision. But to feed its young, which are voracious, it is necessary to lay in a greater store than ordinary, and to give the food a kind of half maceration to suit their tender appetites. The heat of the bird's body, assisted by air and numerous glands separating a milky fluid, are necessary instruments for this operation: but, in proportion as the food macerates, it begins to swell also; and the crop must, of consequence, be considerably dilated. Yet still the air contained in it gives the bird a power of contracting it at pleasure; for if it were filled with more solid substances, the bird could have no power to compress it. But this is not the case; for, driving out the air, it can thus drive out the food also, which is forced up the gullet. The young ones open-mouthed, receive this tribute of affection, and are thus fed three times a day. In feeding, the male usually supplies the young female, while the old female supplies the young of the opposite sex. The food with which they are supplied, is more macerated in the beginning; but as they grow older, the parents give it less preparation, and at last drive them out to shift for themselves. When well fed the old ones do not wait for the total dismission of their young; but in the same nest are to be found young ones almost fit for flight, and eggs hatching at the same time.

The fidelity of the turtle-dove is proverbial, and makes the usual comparison of such poets as are content to repeat what others have said before them; but the pigeon of the dove-house is not so faithful; and having been subjected to man, it puts on licentiousness among its other domestic habits.

So great is the produce of this bird in its domestic state, that nearly fifteen thousand may, in the space of four years, be produced from a single pair. But the stock-dove seldom breeds above twice a-year; for when the winter months come, the whole employment of the fond couple is rather for self-preservation, than transmitting a posterity. They seem, however, to have a stronger attachment to their young than those who are found to breed so often.

It is from a species of these, therefore, that those pigeons which are called Carriers, and are used to convey letters, are produced. These are easily distinguished from all others by their eyes, which are compassed about with a broad circle of naked white skin, and by being of a dark blue or blackish colour. It is from their attachment to their native place, and particularly where they have brought up their young, that these birds are employed in several countries as the most expeditious carriers. They are first brought from the place where they were bred, and whither it is intended to send them back with information. The letter is tied under the bird's wing, and it is then let loose to return. The little animal no sooner finds itself at liberty, than its passion for its native spot directs all its motions. It is seen, upon these occasions, flying directly into the clouds to an amazing height; and then, with the greatest certainty and exactness, directing itself, by some surprising instinct, towards home, which lies sometimes at many miles distance, bringing its message to those to whom it is directed. These birds are not brought up at present with so much care as formerly, when they were sent from governors in a besieged city to generals that were coming to relieve it without; when they were sent from princes to their subjects with the tidings of some fortunate event, or from lovers to their mistresses with expressions of their passion.

The varieties of the tame pigeon are so numerous, that it would be a vain attempt to mention them; so much is the figure and colour of this bird under human controul, that pigeon-fanciers, by coupling a male and female of different sorts, can breed them, as they express it, to a feather. From hence we have the various names of *croppers*, *carriers*, *jacobines*, *powters*, *runts*, and *turbits*: all birds that at first might have accidentally varied from the stock-dove; and then, by having these varieties still heightened by food, climate, and pairing, different species have been produced. But there are many species of the wild pigeon, which, though bearing a strong affinity to the stock-dove, are, nevertheless, sufficiently different from it to deserve a distinct description.—The *ring-dove* is of this number; a good deal larger than the former, and building its nest with a few dry sticks, in the boughs of trees. This seems a bird much fonder of its native freedom than the former; and attempts have been frequently made to render it domestic; but they have hitherto proved fruitless, for though their eggs have been hatched by the tame pigeon in a dove-house, yet, as soon as they could fly, they always betook themselves to the woods where they were first produced. In the beginning of winter these assemble in great flocks in the woods, and leave off cooing; nor do they resume this note of courtship till the beginning of March, when the genial season, by supplying them with food, renews their desires.

The turtle-dove is a smaller, but a much shyer bird than any of the former. It may easily be distinguished from the rest by the iris of the eye, which is of a fine yellow, and by a beautiful crimson circle that encompasses the eye-lids. The fidelity of these birds is noted; and a pair being put in a cage, if one dies the other will not survive it. The turtle-dove is a bird of passage, and few, or none, remain in our northern climates in winter. They fly in flocks when they come to breed here in summer, and delight in open, mountainous, sandy countries. But they build their nests in the midst of woods, and choose the most retired situations for incubation. They feed upon all sorts of grain, but are fondest of millet-seed.

To this short list might be added a long catalogue of foreign pigeons, of which we know little more than the plumage and the names. Indeed, the variety of their plumage is as beautiful, as the names by which they are known are harsh and dissonant. The *ocotzimtzcan*, for instance, is one of the most splendid tenants of the Mexican forests; but few, I believe, would desire to learn the name, only to be informed that it is covered with purple, green, and yellow plumage. To describe such birds, the historian's pen is not half such a useful implement as the painter's pencil.

OF BIRDS OF THE SPARROW KIND IN GENERAL.

DESCENDING from the larger to the smaller, we come to birds of the sparrow kind; or that class of beautiful little animals that, being less than a pigeon, go on diminishing till we arrive at the humming-bird, the smallest of the feathered creation.

The birds which compose this class, chiefly live in the neighbourhood of man, and are his greatest favourites. The falcon may be more esteemed, and the turkey more useful; but these he considers as servants, not as friends; as animals reclaimed merely to supply him with some of the conveniences of life; but these little painted songsters have his affections, as well from their beauty as their melody; it is this delightful class that fill his groves with harmony, and lift his heart to sympathize with their raptures. All the other classes are either mute or screaming; it is this diminutive tribe only that have voices equal to the beauty of their figures; equally adapted to rejoice man, and delight each other.

As they are the favourites of man, so they are chiefly seen near him. All the great birds dread his vicinity, and keep to the thickest darkness of the forest, or the brow of a craggy precipice: but these seldom resort to the thicker parts of the wood; they keep near its edges, in the neighbourhood of cultivated fields, in the hedgerows of farm-grounds, and in the yard, mixing with poultry.

It must be owned, indeed, that their living near man is not a society of affection on their part, as they approach inhabited grounds merely because their chief provision is to be found there. In the depth of the desert, or the gloom of the forest, there is no grain to be picked up; none of these tender buds that are so grateful to their appetites; insects themselves, that make so great a part of their food, are not found there in abundance; their natures being unsuited to the moisture of the place.

There is still another reason for these little birds avoiding the depths of the forest; which is, that their most formidable enemies usually reside there. The greater birds, like robbers, choose the most dreary solitude for their retreats; and if they do not find, they make a desert all around them. The small birds fly from their tyranny, and seek protection in the vicinity of man.

All birds, even those of passage, seem content with a certain district to provide food and centre in. The redbreast or the wren seldom leaves the field where it has been brought up, or where its young have been excluded; even though hunted it flies along the hedge, and seems fond of the place. The fact is, all these small birds mark out a territory to themselves, which they will permit none of their own species to remain in; they guard their dominions with watchful resentment; and we seldom find two male tenants in the same hedge together.

Thus, though fitted by Nature for the most wandering life, these little animals do not make such distant excursions, during the season of their stay, as the stag or the leveret. Food seems to be the only object that puts them in motion, and when that is provided for them in sufficient plenty, they never wander. But as that is seldom permanent through the year, almost every bird is obliged to change its abode. Some are called *birds of passage*, because they are obliged to take long journies for this purpose; but, strictly speaking, almost every other kind are birds of passage, though their migration may not be to places so remote. At some particular season of the year, all small birds migrate either from one country to another, or from the more inland provinces toward the shore.

There are several persons who get a livelihood by watching the seasons when our small birds begin to migrate from one country to another, and by taking them with nets in their passages. The birds are found to fly, as the bird-catchers term it, chiefly during the month of October, and part of September and November. There is also another flight in March, which is much less considerable than that in autumn. Nor is it less remarkable, that several of these species of flight-birds make their appearance in regular succession. The pippet, for instance, begins its flight every year about Michaelmas, when they are caught in greatest number. To this the woodlark succeeds, and continues its flight till towards the middle of October; other birds follow, but are not so punctually periodical; the greenfinch does not begin till the frost obliges it to seek for a change. These birds, during those months, fly from day-break till twelve at noon; and there is afterwards a small flight from two till night. The autumnal flight probably consists of the parents conducting their new-fledged young to those places where there is sufficient provision, and a proper temperament of the air during the winter season; and their return in spring is obviously from an attachment to the place which was found so convenient before for the purposes of nestling and incubation.

Autumn is the principal season when the bird-catcher employs his art to catch these wanderers. His nets are a most ingenious piece of mechanism, being generally twelve yards and a half long, and two yards and a half wide, and so contrived as from a flat position to rise on each side, and clap over the birds that are decoyed to come between them. The birds in their passage are always observed to fly against the wind; hence there is a great contention among the bird-catchers which shall gain the wind; for example, if it is westerly the bird-catcher who lays his nets most to the east, is sure of the most plentiful sport if his call-birds are good. For this purpose he generally carries five or six linnets, two goldfinches, two greenfinches, one woodlark, one redpoll, and perhaps a bullfinch, a yellowhammer, a titlark, and an aberdavine: these are placed at small distances from the nets in little cages. He has besides what he calls his *flur-birds*, which are placed upon a moveable perch, which the bird-catcher can raise at pleasure by means of a string; and these he always lifts gently up and down as the wild bird approaches. But this is not enough to allure the wild bird down; it must be called by one of the call-birds in the cages. The call-birds do not sing upon those occasions as a bird does in a chamber, but incite the wild ones by short jerks, which, when the birds are good, may be heard at a great distance. The allurement of this call is so great, that the wild bird hearing it is stopped in its most rapid flight; and if not already acquainted with the nets, lights boldly within twenty yards perhaps of the bird-catcher, and on a spot which it would otherwise have quite disregarded. This is the opportunity wished for, and the bird-catcher pulling a string, the nets on each side rise in an instant, and clap directly down on the poor little unsuspecting visitant. Nay, it frequently happens, that if half a flock only are caught, the remaining half will immediately afterwards light between the nets, and share the fate of their companions. Should only one bird escape, this unhappy survivor will also venture into danger till it is caught; such a fascinating power have the call-birds.

Singing among birds is almost universally the prerogative of the male. With them it is the reverse of what occurs in the human kind. Among the feathered tribe the heaviest cares of life fall to the lot of the female. Hers is the fatigue of incubation, and to her devolves the principal fatigue of nursing the helpless brood. To alleviate these fatigues, and to support her under them, nature has given the song to the male. This serves as a note of blandishment at first to attract her affections; it serves as a note to delight her during the time of her incubation; but it serves still farther as a note of security, to assure her that no danger threatens to molest her. The male, while his mate is hatching, sits upon some neighbouring tree, continuing at once to watch and to sing. While his voice is heard the female rests in confident security; and as the poet expresses it, appears *most blessed when most unseen:* but if any appearance of danger offers to intrude, the male, that a moment before was so loud and sportive, suddenly stops; and this is a most certain signal to his mate to provide for her own security.

The nest of little birds seems to be of a more delicate contrivance than that of the larger kinds. As the volume of their bodies is smaller, the materials of which their nests are composed are generally warmer. The eggs, therefore, of small birds require a place of more constant warmth than those of great ones, as being liable to cool more quickly; and accordingly their nests are built warmer and deeper, lined on the inside with softer substances, and guarded above with a better covering. The bird whose nest has been robbed several times, builds up her last in a slovenly manner, conscious that from the near approach of winter she must not take time to give her habitation every possible advantage it is capable of receiving. When the nest is finished nothing can exceed the cunning which the male and female employ to conceal it. If it is built in bushes, the pliant branches are so disposed as to hide it from view; if built among moss nothing outwardly appears to show there is a habitation within. It is always built near those places where food is found in greatest abundance; and they take care never to go in or out while there is any one in sight. The greater birds continue from their nest for some time, as their eggs take no damage in their absence; but the little birds are assiduous while they sit, and the nest is always occupied by the male when the female is obliged to seek for sustenance.

The first food of all birds of the sparrow kind is worms and insects. Even the sparrow and the goldfinch, that when adult feed only upon grain, have both been fed upon insects while in the nest. The young ones, for some time after their exclusion from the shell, require no food; but the parent soon finds, by their chirping and gaping, that they begin to feel the approaches of hunger, and flies to provide them a plentiful supply. In her absence they continue to lie close together, and cherish each other by their mutual warmth. During this interval also they preserve a perfect silence, uttering not the slightest note, till the parent returns. Her arrival is always announced by a chirp, which they perfectly undersand, and which they answer all together, each petitioning for its portion. The parent distributes a supply to each by turns, cautiously avoiding to gorge them, but to give them often, though little at a time. The wren will in this manner feed seventeen or eighteen young ones, without passing over one of them.

Such is the manner in which these birds bring forth and hatch their young; but it yet remains to usher them from the nest into life, and this they assiduously perform. When full-fledged, and fitted for short flights, the old ones, if the weather be fair, lead them a few yards from the nest, and then compel them to return. For two or three succeeding days they are led out in the same manner, but each day to seek more distant adventures. When they can fly, and shift for themselves, the parents forsake them for ever, and pay them no more attention than they do to other birds in the same flock. Indeed, it would seem among these little animals, that from the moment their young are set out, all future connection ceases between the male and female; they go separate ways, each to provide for itself during the rigours of winter; and at the approach of spring each seeks for a new associate.

In general, birds, when they come to pair in spring, associate with those of their own age and place of abode. Their strength or courage is generally in proportion to their age; the oldest females first feel the accesses of desire, and the oldest males are the boldest to drive off all younger pretenders.

Willoughby has divided all the smaller birds into those that have slender bills, and those that have short and thick bills. Those with slender bills chiefly live upon insects; those with short strong bills live mostly upon fruits and grain. Among slender-billed birds he enumerates the thrush, the blackbird, the fieldfare, the starling, the lark, the titmouse, and the water-wagtail, the nightingale, the redstart, the robin-redbreast, the beccafigo, the stone-chatter, the whinchat, the goldfinch, the white-throat, the hedge-sparrow, the pettichaps, the golden-crowned wren, the wren, the humming-bird, and several other small birds of the sparrow kind, unknown in this part of the world.

All these live for the most part upon insects; and are of particular benefit to man. By these are his grounds cleared of the pernicious swarms of vermin that would devour the budding leaves and flowers; and even attack the root itself, before the vegetable can come to maturity. These seek for and destroy the eggs of insects that would otherwise propagate in numbers beyond the art of man to extirpate; they know better than man where to seek for them; and thus at once satisfy their own appetites, and render him the most essential services.

But this is not the only merit of this tribe; in it we have the sweetest songsters of the grove; their notes are softer, and their manner more musically soothing than those of hard-billed birds. The foremost in musical fame are, the nightingale, the thrush, the blackbird, the lark, the redbreast, the blackcap, and the wren.

Birds of the sparrow kind, with thick and short bills, are the grossbeak, greenfinch, bullfinch, crossbill, house-sparrow, chaffinch, brambling, goldfinch, linnet, siskin, bunting, yellowhammer, ortolan, wheatear, and several other foreign birds, of which we know rather the names than the history. These chiefly feed upon fruits, grain, and corn. They are often troublesome to man, as they are a numerous tribe: the harvest often suffers from their depredations; and while they are driven off from one end of the field, they fly round, and come in at the other. But these also have their uses: they are frequently the distributors of seeds into different districts; those grains which they swallow are sometimes not wholly digested; and these, laid upon a soil congenial to them, embellish the face of nature with that agreeable variety which art but vainly attempts to imitate.

There are some agreeable songsters in this tribe also; and those who like a loud piercing pipe, endued with great variety and perseverance, will be pleased most with their singing. The songsters of this class are, the canary-bird, the linnet, the chaffinch, the goldfinch, the greenfinch, the bullfinch, the brambling, the siskin, and the yellowhammer. The note of these is not so generally pleasing as that of the soft-billed birds, but it usually holds longer; and in a cage these birds are more easily fed, and hardy.

This class of small birds, like all the greater, has its wanderers, that leave us for a season, and then return, to propagate, to sing, or to embellish the landscape here. Some of this smaller kind indeed are called *birds of passage*, that do not properly come under the denomination; for though they disappear in one place, they never leave the kingdom, but are seen somewhere else. but there are many among them that take longer flights, and go to a region colder or warmer, as it suits their constitutions. The fieldfare and the red-wing breed pass their summers in Norway, and other cold countries, and are tempted hither to our mild winters, and to those various berries which then abound with us, and make their principal food. The hawfinch and the crossbill are uncertain visitants, and have no stated times of migration. Swallows of every species disappear at the approach of winter. The nightingale, the black-cap, the fly-catcher, the willow-wren, the wheatear, the winchat, and the stonechatter, leave us long before the approach of winter; while the siskin and the linnet only forsake us when our winters are more than usually severe. All the rest of the smaller tribe never quit this country; but support the severest rigours of the climate.

Yet it must not be supposed that the manners of our little birds prevail in all other countries; and that such kinds as are stationary with us, never wander in other parts of Europe: on the contrary, many of those kinds which are birds of passage in England, are seen, in other places, never to depart, but to make one country their fixed residence during the year. It is also frequent, that some birds, which with us are faithful residents, in other kingdoms put on the nature of birds of passage, and disappear for a season.

The swallow, that with us is particularly remarked for being a bird of passage, in Upper Egypt, and in the island of Java, breeds and continues the whole year, without ever disappearing. Larks, that remain with us the year throughout, are birds of passage in Sweden; and forsake that climate in winter to return again with the returning spring. The chaffinch that with us is stationary, appears during the winter in Carolina and Virginia; but disappears totally in summer, to breed in the more northern regions. In Sweden, also, these little birds are seen returning, at the approach of spring, from the warmer climates, to propagate; which being accomplished by the latter end of autumn, the males and females separate; the males to continue among their native snows, the females to seek a warmer and gentler winter. On this occasion, they are seen in flocks, that darken all the air, without a single male among them, making their way into the more southern regions of Denmark, Germany, and Holland. In this Amazon-like retreat, thousands fall by the way; some by fatigue, some by want; but the greatest number by the nets of the fowler; the taking them being one of the chief amusements among the gentry where they pass. In short, the change of country with all this little tribe, is rather a pilgrimage than a journey; a migration rather of necessity than of choice.

Having thus given a general idea of the birds of this class, it will be proper to give some account of the most remarkable among them.

OF THE THRUSH AND ITS AFFINITIES.

With the Thrush we may rank the red-wing, the field-fare, the blackbird, the ring-ouzel, and the water-ouzel.

These are the largest of the sparrow kind, and may be distinguished from others of this class, as well by their size as by their bills, which are a little bending at the point; a small notch near the end of the upper chap, and the outmost toe adhering as far as the first joint of the middle toe. To this tribe may be also added the stare or starling, which, though with a flat bill, too much resembles these birds to be placed any where else.

The Missel-Thrush is distinguished from all of the kind by its superior size, being much larger than any of them. It differs scarcely in any other respect from the throstle, except that the spots on the breast are larger. It builds its nest in bushes, or on the side of some tree, as all of this kind are found to do, and lays four or five eggs in a season. Its song is very fine, which it begins in spring, sitting on the summit of a high tree. It is the largest bird of all the feathered tribe that has music in its voice. It feeds on insects, holly, and missleto-berries; and sometimes sends forth a disagreeable scream when frighted or disturbed.

The blackbird, which in cold countries, and particularly upon the Alps, is sometimes seen all over white, is a beautiful and canorous bird, whistling all the spring and summer with a note, at a distance, the most pleasing of all the grove. It is the deepest toned warbler of the woods; but rather unpleasant in a cage, being loud and deafening. It lays four or five bluish eggs, in a nest usually built at the stump of some old hawthorn, well plastered on the inside with clay, straw, and hair.

But pleasing as this bird may be, the Blue-bird, described by Bellonius, is in every respect superior. This beautiful animal resembles a blackbird in all but its blue colour. It lives in the highest parts of the Alps, and even there chooses the most craggy rocks, and the most frightful precipices for its residence. As it is rarely caught, it is in high estimation even in the countries where it breeds, but still more valuable when carried from home. It not only whistles in a delightful manner, but speaks with a distinct voice. It is so docile, and observes all things with such diligence, that though waked at midnight by any of the family, it will speak and whistle at the word of command. Its colour about the beginning of winter, from blue becomes black, which changes to its original hue on the first approaches of spring. It makes its nest in deep holes, in high and inaccessible solitudes, and removes it not only from the accesses of man, but also hides it with surprising cunning from the chamois and other wild beasts that might annoy its young.

The manner of taking this beautiful bird is said to be this. The fowlers, either by chance or by lying in wait, having found out the place where it builds, take with them a strong stilt or stake, such as the climbers of rocks make use of to assist them in their descent. With the assistance of this, they mount where an indifferent spectator would think it impossible to ascend, covering their heads at the same time to ward off any danger of the falling of pebbles or stones from above. At length, with extreme toil and danger, having arrived at the nest, they draw it up from the hole in which it is usually buried, and cherish the young with an assiduity equal to the pains they took to obtain them. It produces for the most part five young, and never more; it seldom descends into the plain country, flies swifter than a blackbird, and uses the same food.

The Fieldfare and the Redwing make but a short stay in this country. With us they are tuneless birds, flying in flocks, and watchful to preserve the general safety. All their season of music and pleasure is employed in more northern climates, where they sing delightfully, perched among the forests of maples, with which they abound. They build their nests in hedges; and lay six bluish-green eggs spotted with black.

The stare. or starling, distinguishable from the rest of this tribe by the glossy green of its feathers, in some lights, and the purple in others, breeds in hollow trees, eaves of houses, towers, ruins, cliffs, and often in high rocks over the sea. It lays four or five eggs of a pale greenish ash-colour, and makes its nest of straw, small fibres of roots, and such like. Its voice is rougher than the rest of this kind; but what it wants in the melody of its note, it compensates by the facility with which it is taught to speak. In winter these birds assemble in vast flocks, and feed upon worms and insects. At the approach of spring they assemble in fields as if in consultation together, and for three or four days seem to take no nourishment: the greater part leave the country; the rest breed here and bring up their young.

To this tribe might be added above a hundred other birds of nearly the thrush size, and living like them upon fruit and berries. Words are insufficient to describe all the beautiful tints that adorn the foreign birds of the thrush kind. The brilliant green of the emerald, the flaming red of the ruby, the purple of the amethyst, or the bright blue of the sapphire, could not, by the most artful combination, show any thing so truly lively or delightful to the sight, as the feathers of the chilcoqui or the tautotol. Passing over these beautiful, but little known birds, I shall mention the American mock-bird, the favourite songster of a region where the birds excel rather in beauty of plumage than the sweetness of their notes.

This valuable bird does not seem to vie with the feathered inhabitants of that country in the beauty of its plumage, content with qualifications that endear it to mankind much more. It is but a plain bird to the eye, about the size of a thrush, of a white and grey colour, and a reddish bill. It is possessed not only of its own natural notes, which are musical and solemn, but it can assume the tone of every other animal in the wood, from the wolf to the raven. It seems even to sport itself in leading them astray. It will, at one time, allure the lesser birds with the call of their males, and then terrify them, when they have come near, with the screams of the eagle. There is no bird in the forest but it can mimic; and there is none that it has not at times deceived by its call. But, not like such as we usually see tamed for mimicking with us, and who have no particular merit of their own, the mock-bird is ever surest to please when it is most itself. At those times it usually frequents the houses of the American planters; and, sitting all night on the chimney-top, pours forth the sweetest and the most various notes of any bird whatever. It would seem, if accounts be true, that the deficiency of most other song-birds in that country, is made up by this bird alone. They often build their nests in the fruit trees about houses, feed upon berries and other fruits, and are easily rendered domestic.

OF THE NIGHTINGALE AND OTHER SOFT-BILLED SONG-BIRDS.

The Nightingale is not only famous among the moderns for its singing, but almost every one of the ancients, who undertook to describe beautiful Nature, has contributed to raise its reputation. 'The nightingale,' says Pliny, 'that, for fifteen days and nights, hid in the thickest shades, continues her note without intermission, deserves our attention and wonder. How surprising that so great a voice can reside in so small a body! such perseverance in so minute an animal! With what a musical propriety are the sounds it produces modulated! The note at one time drawn out with a long breath, now stealing off into a different cadence, now interrupted by a break, then changing into a new note by an unexpected transition, now seeming to renew the same strain, then deceiving expectation. She sometimes seems to murmur within herself; full, deep, sharp, swift, drawling, trembling; now at the top, the middle, and the bottom of the scale! In short, in that little bill seems to reside all the melody which man has vainly laboured to bring from a variety of musical instruments. Some even seem to be possessed of a different song from the rest, and contend with each other with great ardour. The bird overcome is then seen only to discontinue its song with its life.'

This most famous of the feathered tribe visits England in the beginning of April, and leaves it in August. It is found but in some of the southern parts of the country, being totally unknown in Scotland, Ireland, or

North Wales. They frequent thick hedges and low coppices, and generally keep in the middle of the bush, so that they are rarely seen. They begin their song in the evening, and generally continue it for the whole night. For weeks together, if undisturbed, they sit upon the same tree; and Shakspeare rightly describes the nightingale sitting nightly in the same place, which (says Dr. Goldsmith) I have frequently observed she seldom departs from.

From Pliny's description we should be led to believe this bird possessed of a persevering strain; but though it is in fact so with the nightingale in Italy, yet in our hedges in England the little songstress is by no means so liberal of her music. Her note is soft, various, and interrupted; she seldom holds it without a pause above the time that one can count twenty. The nightingale's pausing song would be the proper epithet for this bird's music with us, which is more pleasing than the warbling of any other bird, because it is heard at a time when all the rest are silent.

In the beginning of May the nightingale prepares to make its nest, which is formed of the leaves of trees, straw, and moss. The nest being very eagerly sought after is as cunningly secreted; so that very few of them are found by the boys when they go upon these pursuits. It is built at the bottom of hedges, where the bushes are thickest and best covered. While the female continues sitting, the male at a good distance, but always within hearing, cheers the patient hour with his voice, and by the short interruption of his song often gives her warning of approaching danger. She lays four or five eggs; of which but a part in our cold climate come to maturity.

The delicacy, or rather the fame, of this bird's music, has induced many to abridge its liberty to be secured of its song. But its song in captivity is not so alluring; and the tyranny of taking it from those hedges where only it is most pleasing, still more depreciates its imprisoned efforts. There is a curious story told by Gesner of a friend of his hearing a conversation between two nightingales, who were placed in the room where his friend slept; but as we totally disbelieve it, and think every reasonable being would disbelieve it also, we shall omit it.

There is a little bird rather celebrated for its affection to mankind than its singing, which, however, in our climate, has the sweetest note of all others. The reader already perceives that I mean the red-breast, the well-known friend of man, that is found in every hedge, and makes it vocal. The note of other birds is louder, and their inflexions more capricious; but this bird's voice is soft, tender, and well-supported; and the more to be valued, as we enjoy it the greatest part of the winter. If the nightingale's song has been compared to the fiddle, the red-breast's voice has all the delicacy of the flute.

The red-breast, during the spring, haunts the wood, the grove, and the garden; it retires to the thickest and shadiest hedge-rows to breed in. But in winter it seems to become more domestic, and often to claim protection from man. Most of the soft-billed birds, the nightingale, the swallow, and the titmouse, leave us in the winter, when their insect food is no longer offered in plenty; but the red-breast continues with us the year round, and endeavours to support the famine of winter by chirping round the warm habitations of mankind; by coming into those shelters where the rigour of the season is artificially expelled; and where insects themselves are found in greater numbers, attracted by the same cause.

This bird breeds differently in different places: in some countries its nest is usually found in the crevice of some mossy bank, or at the foot of a hawthorn in hedge-rows; in others, it chooses the thickest coverts, and hides its nest with oak leaves. The eggs are from four to five, of a dull white, with reddish streaks.

The lark, whether the sky-lark, the wood, or the tit-lark, being all distinguishable from other little birds by the length of their heel, are louder in their song than either of the former, but not so pleasing. Indeed, the music of every bird in captivity produces no very pleasing sensations; it is but the mirth of a little animal, insensible of its unfortunate situation; it is the landscape, the grove, the golden break of day, the contest upon the hawthorn, the fluttering from branch to branch, the soaring in the air, and the answering of its young, that gives the bird's song its true relish. These united improve each other, and raise the mind to a state of the highest, yet most harmless exultation. Nothing can, in this situation of mind, be more pleasing than to see the lark warbling upon the wing; raising its note as it soars, until it seems lost in the immense heights above us; the note continuing, the bird itself unseen; to see it then descending with a swell as it comes from the clouds, yet sinking by degrees as it approaches its nest; the spot where all its affections are centered; the spot that has prompted all this joy.

The lark builds its nest upon the ground, beneath some turf that serves to hide and shelter it. The female lays four or five eggs, of a dusky hue in colour, somewhat like those of a plover. It is while she is sitting that the male thus usually entertains her with his singing; and while he is risen to an imperceptible height, yet he still has his loved partner in his eye, nor once loses sight of the nest either while he ascends or is descending. This harmony continues several months, beginning early in the spring on pairing. In winter they assemble in flocks when their song forsakes them, and the bird-catchers destroy them in great numbers for the tables of the luxurious.

The blackcap and the wren, though so very diminutive, are yet prized by some for their singing. The former is called by some the mock nightingale; and the latter is admired for the loudness of its note compared to the little body from whence it issues. It must be confessed that this disproportion between the voice of a bird and its size, in some measure demands our wonder. Quadrupeds in this respect may be considered as mutes to them. The peacock is louder than the lion. But it must be considered that birds are very differently formed; their lungs in some measure are extended through their whole body, while in quadrupeds they lie only in the breast. In birds there are a variety of cells which take in the air, and thus pour forth their contents at the little animal's command. The blackcap and the wren, therefore, are as respectable for their voices, as they might be deemed inconsiderable for their size.

All these soft-billed birds, thus prized for their singing, are rendered domestic, and brought up with assiduity by such as are fond of their voices in a cage. The same method of treatment serves for all, as their food and their habits are nearly the same. The manner of taking and treating them, particularly the nightingale, is this. A nightingale's nest may be found by observing the place where the male sings, and then by sticking two or three meal-worms (a kind of maggot found in flour) on some neighbouring thorn, which when he sees he will infallibly bear away to his young. By listening he then may be heard with the female chirping to the young ones while they are feeding. When the nest is found, if the young are not fledged enough to be taken, they must not be touched with the hands, for then the old ones will perceive it, and entice them away. They should not be taken till they are almost as full of feathers as the old ones; and though they refuse their meat, yet by opening their bills you may give them two or three small bits at a time, which will make them soon grow tame, when they will feed themselves. They should be put, nest and all, into a little basket, which should be covered up warm; and they should be fed every two hours. Their food should be sheep-hearts, or other raw flesh, chopped very fine, and all the strings, skins, and fat, taken away. But it should always be mixed with hen-eggs, boiled hard, upon which they will feed and thrive abundantly.

They should then be put in cages like the nightingale's back cage, with a little straw or dry moss at the bottom; but when they are grown large they should have ant's mould. They should be kept very clean, as indeed should all singing-birds whatsoever; for otherwise they will have the cramp, and perhaps the claws will drop off. In autumn they will sometimes abstain from their food for a fortnight, unless two or three meal-worms be given them twice or thrice a week, or two or three spiders in a day; they must likewise have a little saffron in their water. Figs chopped small among their meat will help them to recover their flesh. When their legs are cramped, they should be anointed with fresh butter, or capon's fat, three or four days together. If they grow melancholy, put white sugar-candy into their water, and feed them with sheep-heart, giving them three or four meal-worms in a day, and a few ants with their eggs. They should also have saffron in the water.

With regard to adult birds those that are taken before the twenty-third of April are accounted the best, because after that they begin to pair. They usually haunt woods, coppices, and quickset hedges, where they may be taken in trap-cages baited with meal-worms. They should be placed as near the spot where the bird sings as possible; and before you fix the trap, turn up the earth twice the breadth of the cage, because they will there look for food. They are also taken with lime twigs, placing them upon the hedge where they usually sing; and there should be meal-worms stuck at proper places to draw them into the snare. After they are taken, their wings should be gently tied with thread, to prevent their beating themselves against the cage. This should be first hung in a private place, that the bird may not be disturbed; and it should be fed every two hours, at farthest, with sheep-heart and egg minced very fine, mixing it with meal-worms. However, the first food must be worms, ants, caterpillars, and flies. You must, to feed the bird, take it in your hand, and open the bill with a stick made thick at one end, giving it the insects, or four or five bits of food as big as peas, to entice it to eat. Its common food should be mixed with ants, so that when the bird goes to pick up the ants, it may pick up some of that also. The nightingale, when caged, begins to sing about the latter end of November, and continues its song till June.

OF THE CANARY-BIRD AND OTHER HARD-BILLED SINGING-BIRDS.

The canary-bird has now become so common, and has continued so long in a domestic state, that its native habits, as well as its native country seem almost forgotten. Though by the name it appears that these birds came originally from the Canary islands, yet we have it only from Germany, where they are bred in great numbers, and sold into different parts of Europe. At what period they were brought into Europe is not known; but it is certain that about a century and a half ago they were sold at very high prices, and kept only for the amusement of the great. They have since been multiplied in great abundance; and their price is diminished in proportion to their plenty.

In its native islands, a region equally noted for the beauty of its landscapes and the harmony of its groves, the canary-bird is of a dusky grey colour, and so different from those usually seen in Europe, that some have even doubted whether it be of the same species. With us they have that variety of colouring usual in all domestic fowls; some white, some mottled, some beautifully shaded with green; but they are more esteemed for their note than their beauty, having a high piercing pipe, as indeed all those of the finch tribe have, continuing for some time in one breath without intermission, then raising it higher and higher by degrees with great variety.

It is this that has rendered the canary-bird, next to the nightingale, the most celebrated songster; and as it is more easily reared than any of the soft-billed birds, and continues its song throughout the year, it is rather the most common in our houses. Rules have been laid down, and instructions given, for breeding these birds in a domestic state; which, as a part of them may conduce towards the natural history of the bird, I shall take leave to transcribe.

In choosing the canary-bird, those are best that appear with life and boldness, standing upright upon the perch, like a sparrow-hawk, and not apt to be frighted at every thing that stirs. If its eyes look cheerful, and not drowsy, it is a sign of health; but, on the contrary, if it hides its head under the wing, gathers its body up, these are symptoms of its being out of order. In choosing them the melody of the song should also be minded: some will open with the notes of the nightingale, and running through a variety of modulations, end like the titlark. Others will begin like the skylark, and by a melodious turn fall into the notes of the nightingale. These are lessons taught in its domestic state, and generally taught it by others; but its native note is loud, shrill, piercing, and enough to deafen the hearers. There are persons who admire each of these songs, but the second is in most estimation.

Canary-birds sometimes breed all the year round; but they most usually begin to pair in April, and to breed in June and August. Those are said to be the best breeders that are produced between the English and the French.

Towards the latter end of March a cock and a hen should be put together in a small cage, where they will peck at each other in the beginning, but will soon become reconciled. The room where they are kept to breed should be so situated as to let the birds have the benefit of the morning sun, and the windows should be of wire, not glass, that they may enjoy the benefit of the air. The floor of the room should be kept clean, and sometimes there should be dry gravel or sand sifted upon it. There should also be two windows, one at each end, and several perches at proper distances for the birds to settle on, as they fly backwards and forwards. A tree in the middle of the room would be the most convenient to divert the birds, and sometimes serve for building their nests upon.

A little breeding cage sometimes suffices for these birds, but seldom any thing more extensive than a small room. While the birds are pairing it is usual to feed them with soft meat; that is, bread, maw-seed, a little scalded rape-seed, and near a third part of an egg. The room should be furnished with stuff for making their nests; such as fine hay, wool, cotton, and hair. These materials should be thoroughly dry, and then mixed and tied together in such a manner that the birds may readily pull out what they want. This should be hung in a proper part of the room, and the male will take his turn in building the nest, sitting upon the eggs, and feeding the young. They are generally two or three days in building their nests; the hen commonly lays five eggs; and in the space of fourteen days the young will be excluded. So prolific are these birds sometimes, that the female will be ready to hatch a second brood before the first are able to quit the nest. On these occasions she leaves the nest and the young, to provide herself with another to lay her new brood in. In the mean time the male, more faithful to the duties of his trust, breeds up the young left behind, and fits them for a state of independence.

When the young birds are excluded, the old ones should be supplied with a sufficiency of soft food every day, with likewise fresh greens, such as cabbage, lettuce, and chickweed; in June, shepherd's purse; and in July and August, plantain. They are never to have groundsel after the young are excluded. With these different delicacies, the old ones will take particular care to feed and bring up their young; but when they can feed themselves, to be taken from the nest and put into cages. Their meat then is the yolk of an egg boiled hard, with an equal quantity of fine bread, and a little scalded rape-seed; this must be bruised till it becomes fine, and then it may be mixed with a little maw-seed; after which blend all together; which is to be supplied them fresh every day.

The canary-bird, by being kept in company with the linnet or the goldfinch, pairs and produces a mixed breed, more like the canary-bird, and resembling it chiefly in its song. Indeed all this tribe with strong bills and piercing notes, and feeding upon grain, have the most strong similitude to each other, and may be justly supposed to come from the same original. They all breed about the same time; frequent the same vegetables; build in the same hedges and trees; and are brought up for the cage with the same food and precautions. The linnet, bullfinch, and goldfinch, when we know the history of the canary-bird, have scarcely any peculiarities that can attract our curiosity, or require our care. The only art necessary with all those that have no very fine note, is to breed them under some more pleasing harmonist. The goldfinch learns a fine song from the nightingale; and the linnet and bullfinch may be taught, forgetting the wild notes of nature, to whistle a long and regular tune.

OF THE SWALLOW AND ITS AFFINITIES.

An idea of any one bird in the former classes will give us a tolerable conception of the rest; but the swallow tribe seems to be different from all the former; different in their form, in their habits, and in all the particulars of their history.

In this tribe is to be found the goat-sucker, which may be styled a nocturnal swallow; it is the largest of this kind, and is known by his tail, which is not forked, like that of the common swallow. It begins its flight at evening, and makes a loud singular noise, like the whur of a spinning-wheel. To this also belongs the house-swallow, which is too well known to need a description; the martin, inferior in size to the former, and the tail much less forked; it differs also in its nest, which is covered at the top, while that of the house swallow is open; and the swift, rather larger than the house-swallow, with all the toes standing forward; in which it differs from the rest of its kind. All these resemble each other so strongly that it is not without difficulty the smaller kinds are known asunder.

These are all known by their large mouths, which, when they fly, are always kept open; they are not less remarkable for their short, slender feet, which are scarcely able to support the weight of their bodies; their wings are of immoderate extent for their bulk; their plumage is glossed with a rich purple: and their note is a slight twittering, which they seldom exert but upon the wing.

This conformation seems attended with a similar peculiarity of manners. Their food is insects, which they always pursue flying. For this reason, during fine weather, when the insects are most likely to be abroad, the swallows are for ever upon the wing, and seem pursuing their prey with swiftness and agility. All smaller animals, in some measure, find safety by winding and turning, when they endeavour to avoid the greater: the lark thus evades the pursuit of the hawk, and man the crocodile. In this manner insects upon the wing endeavour to avoid the swallow; but this bird is admirably fitted by nature to pursue them through their shortest turnings. Besides a great length of wing, it is also provided with a long tail, which, like a rudder, turns it in its most rapid motions; and thus, while it is possessed of the greatest swiftness, it is also possessed of the most extreme agility.

Early in the spring, when the returning sun begins to rouse the insect tribe from their annual state of torpidity; when the gnat and beetle put off their earthly robes and venture into air, the swallow is seen returning from its migration beyond the ocean, and making its way to the shore. At first, with the timidity of a stranger, it appears but seldom, and flies but slowly along. As the weather grows warmer, and its insect supply increases, it gathers greater strength and activity. But it sometimes happens, that a rainy season, by repelling the insects, stints the swallow in its food; the poor bird is then seen slowly skimming along the surface of the ground, and often resting after a flight of a few minutes. But in general it keeps on the wing, and moving with a rapidity that nothing can escape. When the weather promises to be fair, the insect tribe feel the genial influence, and make bolder flights; at that time the swallow follows them in their aerial journeys, and often rises to imperceptible heights in the pursuit. When the weather is likely to be foul, the insects feel the first notices of it; and from the swallows following low we are often apprized of the approaching change.

When summer is fairly begun, and more than a sufficient supply for sustaining the wants of nature every where offers, the swallow then begins to think of forming a progeny. The nest is built with great industry and art, particularly by the common swallow, which builds it on the tops of chimneys. The martin sticks it to the eaves of houses. The goat-sucker, as we are told, builds it on the bare ground. This nest is built with mud from some neighbouring brook, well tempered with the bill, moistened with water, for the better adhesion; and still farther kept firm, by long grass and fibres; within it is lined with goose feathers, which are ever the warmest and the neatest. The martin covers its nest at top, and has a door to enter at; the swallow leaves hers quite open.

The swallow usually lays from five to six eggs, of a white colour, specked with red; and sometimes breeds twice a year. When the young brood are excluded, the swallow supplies them plentifully, the first brood particularly, when she finds herself capable of producing two broods in a year. This happens when the parents come early, when the season is peculiarly mild, and when they begin to pair soon. Sometimes they find a difficulty in rearing even a single nest, particularly when the weather has been severe, or their nests have been robbed in the beginning of the season. By these accidents, this important task is sometimes deferred till the middle of September.

At the latter end of September, they leave us; and for a few days previous to their departure, assemble in vast flocks, on house tops, as if deliberating on the journey that lay before them. This is no slight undertaking, as their flight is directed to Congo, Senegal, and along the whole Morocco shore. But there are some left behind in this general expedition, that do not part till eight or ten days after the rest. These are chiefly the latter weakly broods, which are not yet in a condition to set out. They are sometimes even too feeble to venture, till the setting in of winter; while their parents vainly exhort them to efforts which instinct assures them they are incapable of performing. Thus it often happens, that the wretched little families, being compelled to stay, perish the first cold weather that comes; while the tender parents share the fate of their offspring, and die with their new-fledged brood.

Those that migrate, are first observed to arrive in Africa, as Mr. Adanson assures us, about the beginning of October. They are thought to have performed their fatiguing journey in the space of seven days. They are sometimes seen, when interrupted by contrary winds, wavering in their course far off at sea, and lighting upon whatever ship they find in their passage. They then seem spent with famine and fatigue; yet still they boldly venture, when refreshed by a few hours rest, to renew their flight, and continue the course which they had been steering before.

These are facts proved by incontestible authority; yet it is a doubt whether all swallows migrate in this manner, or whether there may not be some species of this animal that, though extremely alike, are so internally different, as to be differently affected by the approach of winter. We are assured from many, that swallows hide themselves in holes under ground, joined close together, bill against bill, and feet against feet. Some inform us that they have seen them taken out of the water, and even from under the ice, in bunches, where they are asserted to pass the winter, without motion. Reaumur, who particularly interested himself in this inquiry, received several accounts of bundles of swallows being thus found in quarries, and under the water. These men, therefore, have a right to some degree of assent; and are not to lose all credit from our ignorance of what they aver.

OF THE HUMMING-BIRD, AND ITS VARIETIES.

Having given some history of the manners of the most remarkable birds of which accounts can be obtained, I might now go to a very extensive tribe, remarkable for the splendour and the variety of their plumage; but the description of the colours of a beautiful bird, has nothing in it that can inform or entertain; it rather excites a longing, which it is impossible for words to satisfy. We have therefore declined entering into a minute description of foreign birds of the sparrow kind; as sounds would never convey an adequate idea of their beauty.

There is one species however, that I will conclude the history of this class with; which, though the least, will certainly be allowed the most beautiful of all others. Of all the birds that flutter in the garden, or paint the landscape, the humming-bird is the most delightful to look upon, and the most inoffensive.

Of this charming little animal, there are six or seven varieties, from the size of a small wren, down to that of an humble-bee. An European could never have supposed a bird existing so very small, and yet completely furnished out with a bill, feathers, wings, and intestines, exactly resembling those of the largest kind. A bird not so big as the end of one's little finger, would probably be supposed but a creature of imagination, were it not seen in infinite numbers, and as frequent as butterflies in a summer's day, sporting in the fields of America, from flower to flower, and extracting their sweets with its little bill.

The smallest humming-bird is about the size of a hazel-nut. The feathers on its wings and tail are black; but those on its body, and under its wings, are of a greenish brown, with a fine red cast, or gloss, which no silk or velvet can imitate. It has a small crest on its head, green at the bottom, and, as it were gilded at the top; and which sparkles in the sun like a little star in the middle of its forehead. The bill is black, straight, slender, and of the length of a small pin. The larger humming-bird is near half as big as the common wren, and without a crest on its head; but, to make amends, it is covered, from the throat half way down the belly, with changeable crimson-coloured feathers, that, in different lights, change to a variety of beautiful colours, much like an opal. The heads of both are small, with very little round eyes as black as jet.

It is inconceivable how much these add to the high finishing and beauty of a rich western landscape. As soon as the sun is risen, the humming-birds, of different kinds, are seen fluttering about the flowers, without ever lighting upon them. Their wings are in such rapid motion, that it is impossible to discern their colours, except by their glittering. They are never still, but continually in motion, visiting flower after flower, and extracting its honey as if with a kiss. For this purpose they are furnished with a forky tongue, that enters the cup of the flower and extracts its nectared tribute. Upon this alone they subsist. The rapid motion of their wings brings out a humming sound, from whence they have their names; for whatever divides the air swiftly, must produce a murmur.

The nests of these birds are not less curious than the rest: they are suspended in the air, at the point of the twigs of an orange, a pomegranate, or a citron-tree: sometimes even in houses, if they find a small and convenient twig for the purpose. The female is the architect, while the male seeks for materials; such as cotton, fine moss, and the fibres of vegetables. Of these materials a nest is composed, of about the size of a hen's egg cut in two, admirably contrived, and warmly lined with cotton. They lay two eggs at a time, and never more, about the size of small peas, and as white as snow, with here and there a yellow speck. The male and the female sits upon the nest by turns; but the female takes to herself the greatest share. She seldom quits the nest, except a few minutes in the morning and evening, when the dew is upon the flowers, and their honey in perfection. During this short interval the male takes her place; for as the egg is so small, the exposing it ever so short a time to the weather would be apt to injure its contents, the surface exposed being so great in comparison to the bulk. The time of incubation continues twelve days; at the end of which the young ones appear, much about the size of a blue-bottle fly. They are at first bare; by degrees they are covered with down; and at last feathers succeed, but less beautiful at first than those of the old ones.

'Father Labat's companion in the mission to America found the nest of a humming-bird in a shed that was near the dwelling-house, and took it in at a time when the young ones were about fifteen or twenty days old; he then placed them in a cage at his chamber window, to be amused by their sportive flutterings; but he was soon surprised to see the old ones, that came and fed their brood regularly every hour in the day. By these means they themselves soon grew so tame that they seldom quitted the chamber; but without any constraint came to live with their young ones. All four have frequently come to perch upon their master's hand, chirping as if they had been at liberty abroad. He fed them with a very fine clear paste, made of wine, biscuit, and sugar; they thrust their tongues into this paste till they were satisfied, and then fluttered and chirped about the room. I never beheld any thing more agreeable,' continues he, 'than this lovely little family that had taken possession of my companion's chamber, and flew out and in just as they thought proper; but were ever attentive to the voice of their master, when he called them. In this manner they lived with him for above six months; but at a time when he expected to see a new colony formed, he unfortunately forgot to tie up their cage to the ceiling at night, to preserve them from the rats, and he found they were devoured in the morning.'

These birds, on the continent of America, continue to flutter the year round; as their food, which is the honey of flowers, never forsakes them in those warm latitudes where they are found. But it is othsrwise in the islands of the Antilles, where, when the winter season approaches, they retire, and, as some say, continue in a torpid state during the severity of that season. At Surinam and Jamaica, where they constantly have flowers, these beautiful birds are never known to disappear.

It is doubtful whether or not these birds have a continued note in singing. All travellers agree, that beside the humming noise produced by their wings, they have a little interrupted chirp; but Labat asserts, that they have a most pleasing melancholy melody in their voices, though small and proportioned to the organs which produce it. It is probable, that in different places their notes are also different; and as there are some that continue torpid all the winter, there may be others with agreeable voices, though the rest may in general be silent.

The Indians formerly made a great use of this pretty bird's plumage, in adorning their belts and head-dress. The children take them in the fields upon rings smeared with bird-lime: they approach the place where the birds are flying, and twirling their rings in the air, so allure them, either by the colour or the sound, that the simple little creature comes to rest upon the ring, and is seized. They are then instantly killed and gutted, and hung up in the chimney to dry. Those who take greater care, dry them in a stove, which is not so likely to injure the plumage. Their beautiful feathers were once the ornament of the highest rank of savage nobility; but at present they take the bird rather for the purpose of selling it as a curiosity to Europeans, than that of ornament for themselves.

OF BIRDS OF THE CRANE KIND IN GENERAL.

THE progressions in nature from one class of beings to another are always by slow and almost imperceptible degrees. She has peopled the woods and fields with a variety of most beautiful birds; and to leave no part of her territories untenanted, she has stocked the waters with its feathered inhabitants also; she has taken the same care in providing for the wants of her animals in this element, as she has done with respect to those of the other; she has used as much precaution to render water-fowl fit for swimming, as she did in forming land-fowl for flight: she has defended their feathers with a natural oil, and united their toes by a webbed membrane; which gives them at once security and motion. But between the classes of land-birds that shun the water, and water-fowl that are made for swimming and living on it, she has formed a very numerous tribe of birds, that seem to partake of a middle nature; that with divided toes, seemingly fitted to live upon land, is at the same time furnished with appetites that chiefly attach them to the waters. These can properly be called neither land-birds, nor water-fowl, as they provide all their sustenance from watery places, and yet are unqualified to seek it in those depths where it is often found in greatest plenty.

This class of birds, of the crane kind, are to be distinguished from others rather by their appetites than their conformation. Yet even in this respect they seem to be sufficiently discriminated by nature; as they are to live among the waters, yet are incapable of swimming in them, most of them have long legs, fitted for wading in shallow waters, or long bills proper for searching in them.

Every bird of this kind, habituated to marshy places, may be known, if not by the length of its legs, at least by the scaly surface of them. Most birds of this kind are bare of feathers half way up the thigh; at least in all of them above the knee. Their long habits of wading in the waters, and having their legs continually in moisture, prevents the growth of feathers on those parts.

The bill also is very distinguishable in most of this class. It is in general longer than that of other birds, and in some finely fluted on every side; while at the point it is possessed of extreme sensibility, and furnished with nerves, for the better feeling their food at the bottom of marshes, where it cannot be seen. Some birds of this class are thus fitted with every convenience; they have long legs, for wading; long neck, for stooping; long bills, for searching; and nervous points, for feeling. Others are not so amply provided for; as some have long bills, but legs of no great length; and others have long bills but very short legs. It is a rule which universally holds, that where the bird's legs are long, the neck is also long in proportion.

If we consider the natural power of this class, in a comparative view, they will seem rather inferior to those of every other tribe. Their nests are more simple than those of the sparrow; and their methods of obtaining food less ingenious than those of the falcon; the pie exceeds them in cunning; and though they have all the voraciousness of the poultry tribe, they want their fecundity. None of this kind have been taken into man's society, or under his protection; they are neither caged or kept tame; but lead a life of precarious liberty, in fens and marshes, at the edges of lakes, and along the sea-shore. They all live upon fish or insects, one or two only excepted; even those that are called *mud-suckers*, such as the snipe and woodcock, it is more than probable, search the bottom of marshy places only for such insects as are deposited there by their kind, and live in a vermicular state in pools and plashes, till they take wing, and become flying insects.

All this class, therefore, that are fed upon insects, their food being easily digestible, are good to be eaten; while those who live entirely upon fish, abounding in oil, acquire in their flesh the rancidity of their diet, and are generally unfit for the table. To savages, indeed, and sailors on a long voyage, every thing that has life seems good to be eaten; and we often find them recommending those animals as dainties, which they would spurn at after a course of good living.

In treating of this class of birds, it will be best to observe the simplest method possible; neither to load the memory with numerous distinctions, nor confuse the imaginations by a want of arrangement. I will therefore describe some of the larger sorts separately; as in a history of birds each of these demands distinction. The crane, the stork, the Balearic crane, the heron, the bittern, with some others, may require a separate history. Some particular tribes may next offer, that may naturally be classed together; and as for the smaller and least remarkable sorts, they may be placed in one general description.

THE CRANE.

There is something extraordinary in the different accounts we have of this bird's size and dimensions. Willoughby and Pennant make the crane from five to six feet long, from the tip to the tail. Other accounts say, that it is above five feet high; and others, that it is as tall as a man. From the many which I myself had seen, I own this imputed magnitude surprised me; as from memory I was convinced, they could neither be so long nor so tall. Indeed, a bird, the body of which is not larger than that of a turkey-hen, and acknowledged by all not to weigh above ten pounds, cannot easily be supposed to be almost as long as an ostrich. Brisson seems to give this bird its real dimensions, when he describes it as something less than the brown stork, about three feet high, and about four from the tip to the tail. Still, however, the numerous testimonies of its superior size are not to be totally rejected; and perhaps that from which Brisson took his dimensions was one of the smallest of the kind.

The crane, taking its dimensions from him, is exactly three feet four inches from the tip to the tail, and four feet from the head to the toe. It is a tall slender bird, with a long neck and long legs. The top of the head is covered with black bristles, and the back of it is bald and red, which distinguishes it from the stork, to which it is very nearly allied in size and figure. The plumage in general is ash-coloured; and there are two large tufts of feathers that spring from the pinion of each wing. These bear a resemblance to hair, and are finely curled at the ends, which the bird has a power of erecting and depressing at pleasure. Gesner says, that these feathers in his time used to be set in gold, and worn as ornaments in caps.

Such are the dimensions of a bird, concerning which, not to mention modern times, there have been more fables propagated than of any other. It is a bird with which all the ancient writers are familiar; and, in describing it, they have not failed to mix imagination with history.

The crane is certainly a very social bird, and they are seldom seen alone. Their usual method of flying or sitting, is in flocks of fifty or sixty together; and while a part feed, the rest stand like centinels upon duty.

The crane is a wandering, sociable bird, that for the most part subsists upon vegetables; and is known in every country of Europe, except our own. There is no part of the world, says Bellonius, where the fields are cultivated, and the crane does not come in with the husbandman for a share in the harvest. As they are birds of passage, they are seen to depart, and return regularly at those seasons when their provision invites or repels them. They generally leave Europe about the latter end of autumn, and return in the beginning of summer. In the inland parts of the continent, they are seen crossing the country in flocks of fifty or a hundred, making from the northern regions towards the south. In these migrations, however, they are not so resolutely bent upon going forward, but that if a field of corn offers in their way, they will stop awhile to regale upon it: on such occasions they do incredible damage, chiefly in the night; and the husbandman, who lays down in joyful expectation, rises in the morning to see his fields laid waste, by an enemy, whose march is too swift for his vengeance to overtake.

Our own country is free from their visits; not but that they were formerly known in this island, and held in great estimation for the delicacy of their flesh; there was even a penalty upon such as destroyed their eggs; but, at present, they never go so far out of their way. Cultivation and populousness go hand in hand; and, though our fields may offer them a great plenty, yet it is so guarded, that the birds find the venture greater than the enjoyment; and probably we are much better off by their absence than their company. Whatever their flesh might once have been, when, as Plutarch tells us, cranes were blinded and kept in coops, to be fattened for the tables of the great in Rome; or, as they were brought up, stuffed with mint and rue, to the tables of our nobles at home: at present, they are considered all over Europe as wretched eating. The flesh is fibrous and dry, requiring much preparation to make it palatable; and even after every art, it is fit only for the stomachs of strong and labouring people.

The cold Arctic region seems to be this bird's favourite abode. They come down into the more southern parts of Europe, rather as visitants than inhabitants: yet it is not well known in what manner they portion out their time, to the different parts of the world. The crane changes place, like a wanderer; he spends the autumn in Europe; he then flies off, probably to some more southern climate, to enjoy a part of the winter; returns to Europe in the spring; crosses up to the north in summer; visits those lakes that are never dry; and then comes down again to make depredations upon our cultivated grounds, in autumn. Thus Gesner assures us, that the cranes usually begin to quit Germany, from about the eleventh of September to the seventeenth of October; from thence they were seen flying southward by thousands; and Redi tells us, they arrive in Tuscany a short time after. There they tear up the fields, newly sown, for the grain just committed to the ground, and do great mischief. It is to be supposed that in the severity of winter, they go southward, still nearer the line. They again appear in the fields of Pisa, regularly about the twentieth of February, to anticipate the spring.

In these journeys, it is amazing to conceive the heights to which they ascend, when they fly. Their note is the loudest of all other birds; and that is often heard in the clouds, when the bird itself is entirely unseen. As it is light for its size, and spreads a large expanse of wing, it is capable of floating at the greatest height, where the air is lightest; and as it secures its safety, and is entirely out of the reach of man, it flies in tracts which would be too fatiguing for any other birds to move forward in.

In these aerial journeys, though unseen themselves, they have the distinctest vision of every object below. They govern and direct their flight by their cries; and exhort each other to proceed or to descend, when a fit opportunity offers for depredation. Their voice, it was observed, is the loudest of all the feathered tribe; and its peculiar clangor arises from the extraordinary length and contortion of the windpipe. In quadrupeds, the windpipe is short, and the glottis or cartilages that form the voice, are at that end of it which is next the mouth; in water-fowl, the wind-pipe is longer, but the cartilages that form the voice, are at the other end, which lies down in their belly. By this means they have much louder voices, in proportion to their size, than any other animals whatever; for the note when formed below, is reverberated through all the rings of the windpipe, till it reaches the air. But the voice of the duck or the goose, is nothing to be compared to that of the crane, whose windpipe is not only made in the same manner with theirs, but is above twenty times as long. Nature seems to have bestowed much pains in lengthening out this organ. From the outside, it enters through the flesh into the breast-bone, which hath a great cavity within to receive it. There being thrice reflected, it goes out again at the same hole, and so turns down to the lungs, and thus enters the body a second time. The loud clangorous sound, which the bird is thus enabled to produce, is, when near, almost deafening: but it is particularly serviceable to the animal itself, either during its migrations or its stay: by it the flock is encouraged in their journeys; and if, while feeding, which is usually performed in silence, they are invaded, the bird that first perceives the danger, sounds the alarm, and all are speedily upon the wing.

As they rise but heavily, they are shy birds, and seldom let the fowler approach them. Their depredations are usually made in dark nights; when they enter a field of corn, and trample it down, as if it had been crossed over by a regiment of soldiers. On other occasions, they choose some solitary marsh, where they range themselves all day, as if in deliberation; and not having that grain which is most to their appetites, wade the marshes for insects, which they can procure with less danger.

Corn is their favourite food; but scarcely any other comes amiss to them. Redi, who opened several, found the stomach of one full of the herb called *dandelion;* that of another was filled with beans; a third had a great quantity of clover in its stomach; while that of two others was filled with earth-worms and beetles: in some he found lizards and sea-fish; in others snails, grass, and pebbles, swallowed perhaps for medical purposes. It seems, therefore, that these birds are easily supplied; and that they are noxious to corn-fields but on some particular occasions.

In general it is a peaceful bird, both in its own society, and with respect to those of the forest. Though so large in appearance, a little falcon pursues, and often disables it. The method is, with those who are fond of hawking, to fly several hawks together against it; which the crane endeavours to avoid, by flying up perpendicularly, till the air becomes too thin to support it any higher. The hawk, however, still bears it company; and though less fitted for floating in so thin a medium, yet, possessed of greater rapidity, it still gains the ascendancy. They both often rise out of sight; but soon the spectator, who keeps his eye fixed above, perceives them, like two specks, beginning to appear: they gather on his eye for a little space, and shortly after come tumbling perpendicularly together, with great animosity on the side of the hawk, and a loud screaming on that of the crane. Thus driven to extremity, and unable to fly, the poor animal throws itself upon its back, and, in that situation, makes a most desperate defence, till the sportsman coming up, generally puts an end to the contest with its life.

It was formerly the barbarous custom to breed up cranes to be thus baited; and young ones were taken from the nest, to be trained up for this cruel diversion. It is an animal easily tamed; and, if we can believe Albertus Magnus, has a particular affection for man. This quality, however, was not sufficient to guard it from being made the victim of his fierce amusements. The female, which is easily distinguished from the male, by not being bald behind as he is, never lays above two eggs at a time; being like those of a goose, but of a bluish colour. The young ones are soon fit to fly, and then the parents forsake them to shift for themselves; but, before this time, they are led forth to the places where their food is most easily found. Though yet unfledged, they run with such swiftness that a man cannot easily overtake them. We are told, that as they grow old, their plumage becomes darker; and, as a proof of their longevity, Aldrovandus assures us, that a friend of his kept one tame for above forty years.

Whatever may have been the disposition of the great, the vulgar of every country bear the crane a compassionate regard. It is possible the ancient prejudices in its favour, which once having been planted, are eradicated but slowly, may still continue to operate. In some countries, it is considered as an heinous offence to kill a crane; and though the legislature declines to punish, yet the people do not fail to resent the injury. The crane, they, in some measure, consider as the prophet of the season: upon its approach or delay they regulate the periods of rural economy. If their favourite bird comes early in the season, they expect a plentiful summer; if he is slow in his visits, they then prepare for an unfavourable spring. Whatever wisdom there may be in despising the prejudices of the vulgar, there is but little in condemning them. They have generally had their origin in good motives; and it should never be our endeavours to suppress any tender emotions of friendship or pity, in those hard breasts that are, in general, unsusceptible of either.

THE STORK.

If we regard the stork externally only, we shall be apt to confound it with the crane. It is of the same size; it has the same formation as to the bill, neck, legs, and body, except that it is more corpulent. Its differences are but very slight; such as the colour, which, in the crane, is ash and black, but in the stork, is white and brown. The nails of the toes of the stork also are not clawed like those of other birds, but flat like the nails of man.

But these are slight differences; and its true distinctions are to be taken rather from its manners than its form. The crane has a loud piercing voice; the stork is silent, and produces no other noise than the clacking of its under-chap against the upper: the crane has a strange convolution of the wind-pipe through the breastbone; the stork's is formed in the usual manner: the crane feeds mostly upon vegetables and grain; the stork preys entirely upon frogs, fishes, birds, and serpents: the crane avoids towns and populour places; the stork lives always in or near them: the crane lays but two eggs, and the stork generally four. These distinctions mark the species, notwithstanding their similitude of form.

Storks are birds of passage, like the former; but it is hard to say whence they come or whither they go. When they withdraw from Europe, they all assemble on a particular day, and never leave one of their company behind them. They take their flight in the night; which is the reason the way they go has never been observed. They generally return into Europe in the middle of March, and make their nests on the tops of chimneys and houses, as well as of high trees. The females lay from two to four eggs, of the size and colour of those of geese; and the male and female sit upon them by turns. They are a month in hatching; and when their young are excluded, they are particularly solicitous for their safety.

As the food of these birds consists in a great measure of frogs and serpents, it is not to be wondered at that different nations have paid them a particular veneration. The Dutch are very solicitous for the preservation of the stork. This bird seems to have taken refuge among their towns; and builds on the tops of their houses without molestation. There it is seen resting familiarly in the streets, and protected as well by the laws as the prejudices of the people.

The stork seems a general favourite even among the moderns; but the ancient Egyptians carried their regard even to adoration. This enlightened people, who worshipped the Deity in his creatures, paid divine honours to the ibis, as is universally known. It has been supposed that the ancient ibis is the same with that which goes at present by the same name; a bird of the stork kind, of about the size of a curlew, all over black, with a bill very thick in the beginning, but ending in a point for the better seizing its prey, which is caterpillars, locusts, and serpents. But however useful the modern ibis may be in ridding Egypt, where it resides, of the vermin and venomous animals that infest it; yet it is much doubted whether this be the same ibis to which the ancients paid their adoration. Maillet, the French consul at Cairo, observes, that it is very hard to determine what bird the ancient ibis certainly was, because there are cranes, storks, hawks, kites, and falcons, that are all equally enemies to serpents, and devour a vast number. He farther adds, that in May, when the winds begin to blow from the internal parts of Africa, there are several sorts of birds that come from Upper Egypt, from whence they are driven by the rains in search of a better habitation, and that it is then they do this country such signal services. The modern ibis is not peculiar to Egypt, as it is to be seen but at certain seasons of the year; whereas we are informed by Pliny, that this bird was seen no where else. It is thought, therefore, that the true ibis is a bird of the vulture kind, described above, and called by some the *capon of Pharaoh*, which not only is a devourer of serpents, but will follow the caravans that go to Mecca, to feed upon the offal of the animals that are killed on the journey.

OF THE BALEARIC AND OTHER FOREIGN CRANES.

There have been disputes concerning the real Balearic crane; but the bird that we are about to describe under that name was unknown to the ancients, and the heron or egret ought to be reinstated in their just title to that name.

When we see a very extraordinary animal, we are naturally led to suppose that there must be something also remarkable in its history to correspond with the singularity of its figure. But it often happens that history fails on those occasions where we most desire information. In the present instance, in particular, no bird presents to the eye a more whimsical figure than this, which we must be content to call the *balearic crane*. It is nearly of the shape and size of the ordinary crane, with long legs and a long neck, like others of the kind; but the bill is shorter, and the colour of the feathers of a dark greenish grey. The head and throat form the most striking part of this bird's figure. On the head is seen standing up a thick round crest, made of bristles, spreading every way, and resembling rays standing out in different directions. The longest of these rays are about three inches and a half, and they are all topped with a kind of black tassels, which give them a beautiful appearance. The sides of the head and cheeks are bare, whitish, and edged with red, while underneath the throat hangs a kind of bag, like that of a cock, but not divided into two. The eye is large and staring; the pupil black and big, surrounded with a gold-coloured iris, that completes the bird's singular appearance.

From such a description of its figure we might be led to wish for a minute history of its manners; but of these we can give but slight information. This bird comes from the coast of Africa and the Cape de Verd islands. As it runs it stretches out its wings, and goes swiftly; otherwise its usual motion is slow. In their domestic state they walk deliberately among other poultry, and suffer themselves to be approached by almost every spectator. They never roost in houses but about night; when they are disposed to go to rest, they search out some high wall, on which they perch in the manner of peacocks. Indeed they so much resemble that bird in manners and disposition, that some have described them by the name of the *sea peacock;* and Ray has been inclined to rank them in the same family. But though their voice and roosting be similar, their food, which is entirely upon greens, vegetables, and barley, seems to make some difference.

In this chapter of foreign birds of the crane kind, it will be proper to mention the jabiru and the jabiru guacu, both natives of Brasil. Of these great birds of the crane kind we know but little, except the general outline of their figure, and the enormous bills which we see preserved in the cabinets of the curious. The bill of the latter is red, and thirteen inches long; the bill of the former is black, and found to be eleven. Neither of them are of a size proportioned to their length of bill. The jabiru guacu is not above the size of a common stork, while the jabiru with the smallest bill exceeds the size of a swan. Both are covered with white feathers, except the head and neck, which are naked; and their principal difference is in the size of the body and the make of the bill; the lower chap of the jabiru guacu being broad, and bending upwards.

A bird still more extraordinary may be added to this class, called the *anhima*, and, like the two former, a native of Brasil. This is a water-fowl of the rapacious kind, and bigger than a swan. The head, which is small for the size of the body, bears a black bill, which is not above two inches long; but what distinguishes it in particular is a horn growing from the forehead as long as the bill, and bending forward. This horn is not much thicker than a crow-quill, as round as if it were turned in a lathe, and of an ivory colour. But this is not the only instrument of battle this bird carries; it seems to be armed at all points; for at the fore part of each wing, at the second joint, spring two straight triangular spurs, about as thick as one's little finger: the foremost of these goads or spurs is above an inch long; the hinder is shorter, and both of a dusky colour. The claws are long and sharp; the colour black and white; and they cry terribly loud, sounding something like *vyhoo, vyhoo.* They are never found alone, but always in pairs; the cock and hen prowl together; and their fidelity is said to be such, that when one dies, the other never departs from the carcase, but dies with its companion. It makes its nest of clay, near the bodies of trees, upon the ground, of the shape of an oven.

One bird more may be subjoined to this class, not for its figure, but its manners. Our sailors call it the *buffoon bird*, and the French the *demoiselle* or *lady*. The peculiar gestures and contortions of this bird, the proper name of which is the *Numidian crane*, are very singular; and the French, who are skilled in the arts of elegant gesticulation, consider all its motions as lady-like and graceful. But our English sailors, who have not entered so deeply into the dancing art, think, that while thus in motion the bird cuts a ridiculous figure. It stoops, rises, lifts one wing, then another, turns round, sails forward, then back again; all which highly diverts our seamen; not imagining perhaps, that all these contortions are but the awkward expression, not of the poor animal's pleasures, but its fears.

It is a very scarce bird; the plumage is of a leaden grey; but it is distinguished by fine white feathers, consisting of long fibres, which fall from the back of the head, about four inches long; while the fore part of the neck is adorned with black feathers, composed of fine, soft, and long fibres, that hang down upon the stomach, and give the bird a very graceful appearance. The ancients have described a buffoon bird, but there are many reasons to believe that theirs is not the Numidian crane. It comes from that country from whence it has taken its name.

OF THE HERON AND ITS VARIETIES.

Birds of the crane, the stork, and the heron kind bear a strong affinity to each other; and their differences are not easily discernible. As for the crane and the stork, they differ rather in their nature and internal conformation than in their external figure; but still they may be known asunder, as well by their colour as by the stork's claws, which are peculiar, and more resembling a man's nails than the claws of a bird. The heron may be distinguished from both, as well by its size, which is less, as by its bill, which is longer in proportion; but particularly by the middle claw on each foot, which is toothed like a saw, for the better seizing and holding its slippery prey. Should other marks fail, there is an anatomical distinction, in which herons differ from all other birds; which is, that they have but one cæcum, and all other birds have two.

Of this tribe Brisson enumerates not less than forty seven sorts, all differing in size, figure, and plumage; and with talents adapted to their place of residence, or their peculiar pursuits. But how various soever the heron kind may be in their colours or bills, they all seem possessed of the same manners, and have but one character of cowardice and rapacity, indolence, yet immoderate hunger. Other birds grow fat by an abundant supply of food; but these, though destructive and voracious, have always lean and carrion bodies, as if plenty were not sufficient for their support.

The common heron is light, in proportion to its bulk, scarcely weighing three pounds and a half, yet it expands a breadth of wing which is five feet from tip to tip. Its bill is five inches from the point to the base; its claws are long, sharp, and the middlemost toothed like a saw. Yet thus armed as it appears for war, it is cowardly, and flies at the approach of a sparrow-hawk. It was once the amusement of the great to pursue this timorous creature with the falcon; and heron-hawking was so favourite a diversion among our ancestors that laws were enacted for the preservation of the species;

and the person who destroyed their eggs was liable to a penalty of twenty shillings for each offence.

But at present the effects of the ill-judged policy of our ancestors, is felt by their posterity; for, as the amusement of hawking has given place to the method of stocking fish ponds, the heron is now become a most formidable enemy. Of all other birds this commits the greatest devastation in fresh-waters; and there is scarcely a fish that he will not strike at and wound, though unable to carry it away. But the smaller fry are his chief subsistence; these, pursued by their larger fellows of the deep, are obliged to take refuge in shallow waters, where they find the heron a more formidable enemy. He wades as far as he can go into the water, and there patiently waits the approach of his prey, which when it comes within sight, he darts upon with inevitable aim; so that he destroys more in a week than an otter in three months. 'I have seen a heron,' says Willoughby, 'that had been shot, that had seventeen carps in his belly at once, which he will digest in six or seven hours, and then to fishing again. I have seen a carp,' continues he, 'taken out of a heron's belly, nine inches and a half long. Several gentlemen who kept tame herons, to try what quantity one of them would eat in a day, have put several smaller roach and dace in a tub; and they have found him eat fifty in a day, one day with another. In this manner a single heron will destroy fifteen thousand carp in half a year.'

So great are the digestive powers of this fresh-water tyrant, and so detrimental to those who stock ponds with fish. In general he is seen taking his gloomy stand by the lake's side, as if meditating mischief. His usual attitude on this occasion is to sink his long neck between his shoulders, and keep his head turned on one side, as if eyeing the pool more intently. When the call of hunger returns, the toil of an hour or two is generally sufficient to fill his capacious stomach; and he retires long before night to his retreat in the woods; but early in the morning he is seen assiduous at his usual occupation.

Though in seasons of fine weather the heron can always find a plentiful supply; in cold or stormy seasons, his prey is not within reach: the fish that before came into the shallow water, now keep in the deep; as they find it to be the warmest situation. Frogs and lizards also seldom venture from their lurking places; and the heron supports himself upon his long habits of patience, and even takes up with the weeds that grow upon the water. At those times he contracts a consumptive disposition, which succeeding plenty is not able to remove; so that the meagre glutton spends his time between want and riot, and feels alternately the extremes of famine and excess. Hence, notwithstanding the care with which he takes his prey, and the amazing quantity he devours, the heron is lean and emaciated; and though his crop be usually found full, yet his flesh is scarcely sufficient to cover the bones.

The heron usually takes his prey by wading into the water, yet it must not be supposed that he does not also take it upon the wing. Much of his fishing is performed in this manner; but he never hovers over deep waters, as there his prey is enabled to escape him by sinking to the bottom. In shallow places he darts with more certainty; for though the fish at sight of its enemy instantly descends, yet the heron, with his long bill and legs, pins it to the bottom, and seizes it securely. Thus, after having been seen with his long neck for above a minute under water, he rises upon the wing, with a trout or an eel struggling in his bill to get free. But the greedy bird flies to the shore, scarcely gives it time to expire, but swallows it whole, and then returns to fishing as before.

As this bird does incredible mischief to ponds newly stocked, Willoughby has given a receipt for taking them.—'Having found his haunt, get three or four small roach or dace, and having provided a strong hook with a wire to it, this is drawn just within-side the skin of the fish, beginning without-side the gills, and running it to the tail, by which the fish will not be killed, but continue for five or six days alive. Then having a strong line made of silk and wire, about two yards and a half long, it is tied to a stone at one end, the fish with the hook being suffered to swim about at the other. This being properly disposed in shallow water, the heron will seize upon the fish to its own destruction. From this method we may learn, that the fish must be alive, otherwise the heron will not touch them, and that this bird, as well as all those that feed upon fish, must be its own caterer; for they will not prey upon such as die naturally, or are killed by others before them.'

Though this bird lives chiefly among pools and marshes, yet its nest is built on the tops of the highest trees, and sometimes on cliffs hanging over the sea. They are never in flocks when they fish, for they commit their depredations in solitude and silence; but in making their nests they love each other's society; and they are seen, like rooks, building in company with flocks of their kind. Their nests are made of sticks, and lined with wool; and the female lays four large eggs of a pale green colour. The observable indolence of their nature, however, is not less seen in their nestling than in their habits of depredation. Nothing is more certain, and I have seen it a hundred times, than that they will not be at the trouble of building a nest when they can get one made by the rook. or deserted by the owl, already provided for them. This they usually enlarge and line within, driving off the original possessors, should they happen to renew their fruitless claims.

The French seem to have availed themselves of the indolence of this bird in making its nest; and they provide a place with materials fitted for their nestling, which they call *heronries*. The heron, which with us is looked upon as totally unfit for the table, is more sought for in France, where the flesh of the young is in particular estimation. To obtain this, the natives raise high sheds along some fishy stream; and furnishing them with materials for the herons to nestle with, these birds build and breed there in abundance. When the young ones are supposed to be fit, the owner of the heronry comes, as we do into a pigeon-house, and carries off such as are proper for eating; and these are sold for a good price to the neighbouring gentry. 'These are a delicacy which,' as my author says, 'the French are very fond of, but which strangers have not yet been taught to relish as they ought.' Nevertheless it was formerly much esteemed as food in England, and made a favourite dish at great tables. It was then said that the flesh of a heron was a dish for a king; at present nothing about the house will touch it but a cat.

With us, therefore, as the heron, both old and young, is thought detestable eating, we seldom trouble them in their heights, which are for the most part sufficiently inaccessible. Their nests are often found in great numbers in the middle of large forests, and in some groves nearer home, where the owners have a predilection for the bird, and do not choose to drive it from its accustomed habitations. Yet by their cries, expansive wings, bulk, and wavy motion, they add solemnity to the forest, and give a pleasing variety to a finished improvement.

When the young are excluded, as they are numerous, voracious, and importunate, the old ones are for ever upon the wing to provide them with abundance. The quantity of fish they take upon this occasion is amazing, and their size is not less to be wondered at. I remember a heron's nest that was built near a school-house; the boys, with their usual appetite for mischief, climbed up, took down the young ones, sewed up their vents, and laid them in the nest as before. The pain the poor little animals felt from the operation increased their cries; and this but served to increase the diligence of the old ones in enlarging their supply. Thus they heaped the nest with various sorts of fish, and the best of their kind; and as their young screamed they flew off for more. The boys gathered up the fish, which the young ones were incapable of eating, till the old ones quitted their nest, and gave up their brood, whose appetites they found it impossible to satisfy.

The heron is said to be a very long-lived bird; by Mr. Keysler's account, it may exceed sixty years; and by a recent instance of one that was taken in Holland, by a hawk belonging to the Stadtholder, its longevity is again confirmed, the bird having a silver plate fastened to one leg, with an inscription, importing, that it had been struck by the elector of Cologne's hawks thirty-five years before.

OF THE BITTERN, OR MIRE-DRUM.

Those who have walked in an evening by the sedgy sides of unfrequented rivers, must remember a variety of notes from different water-fowl: the loud scream of the wild-goose, the croaking of the mallard, the whining of the lapwing, and the tremulous neighing of the jack-snipe. But of all these sounds, there is none so dismally hollow as the booming of the bittern. Words cannot give those who have not heard this evening-call an adequate idea of its solemnity. It is like the interrupted bellowing of a bull, but hollower and louder, and is heard at a mile's distance, as if issuing from some formidable being that resided at the bottom of the waters.

The bird, however, that produces this terrifying sound, is not so big as a heron, with a weaker bill, and not above four inches long. It differs from the heron chiefly in its colour, which is in general of a palish yellow, spotted and barred with black. Its windpipe is fitted to produce the sound for which it is remarkable; the lower part of it dividing into the lungs is supplied with a thin loose membrane, that can be filled with a large body of air and exploded at pleasure. These bellowing explosions are chiefly heard from the beginning of spring to the end of autumn; and, however awful they may seem to us, are the calls to courtship.

From the loudness and solemnity of the note, many have been led to suppose, that the bird made use of external instruments to produce it, and that so small a body could never eject such a quantity of tone.

It hides in the sedges by day, and begins its call in the evening, booming six or eight times, and then discontinuing for ten or twenty minutes to renew the same sound. This is a call it never gives but when undisturbed and at liberty. When its retreats among the sedges are invaded, when it dreads or expects the approach of an enemy, it is then silent. In domestic captivity it never utters this call, but continues, under the controul of man, a mute forlorn bird, equally incapable of attachment or instruction. But though its boomings are always performed in solitude, it has a scream which is generally heard upon the seizing its prey, and which is sometimes extorted by fear.

This bird, though of the heron kind, is yet neither so destructive nor so voracious. It is a retired timorous animal, concealing itself in the midst of reeds and marshy places, and living upon frogs, insects, and vegetables; and though so nearly resembling the heron in figure, yet differing much in manners and appetites. As the heron builds on the tops of the highest trees, the bittern lays its nest in a sedgy margin, or amidst a tuft of rushes. The heron builds with sticks and wool; the bittern composes its simpler habitations of sedges, the leaves of water-plants, and dry rushes. The heron lays four eggs; the bittern generally seven or eight, of an ash-green colour. The heron feeds its young for many days; the bittern in three days leads its little ones to their food. In short, the heron is lean and cadaverous, subsisting chiefly upon animal food; the bittern is plump and fleshy, as it feeds upon vegetables when more nourishing food is wanting.

It cannot be, therefore, from its voracious appetites, but its hollow boom, that the bittern is held in such detestation by the vulgar. I remember in the place where I was a boy with what terror this bird's note affected the whole village; they considered it as the presage of some sad event; and generally found or made one to succeed it. I do not speak ludicrously; but if any person in the neighbourhood died, they supposed it could not be otherwise, for the night-raven had foretold it: but if nobody happened to die, the death of a cow or a sheep gave completion to the prophecy.

Whatever terror it may inspire among the simple its flesh is greatly in esteem among the luxurious. For this reason it is as eagerly sought after by the fowler, as it is shunned by the peasant; and as it is a heavy-rising, slow-winged bird, it does not often escape him. Indeed it seldom rises but when almost trod upon, and seems to seek protection rather from concealment than flight. At the latter end of autumn, in the evening, its indolence appears to forsake it. It is then seen rising in a spiral ascent, till quite lost from the view, making a singular noise different from its former boomings. Thus the same animal is often seen to assume different desires; and while the Latins have given the bittern the name of the star-reaching bird (or the *stellaris*) the Greeks, taking its character from its more constant habits, have given it the title of *oknos*, or the lazy.

OF THE SPOONBILL, OR SHOVELER.

As we proceed in our description of the crane kind, birds of peculiar forms offer, not entirely like the crane, and yet not so far distant as to rank more properly with any other class. Where the long neck and stilt-like legs of the crane are found, they make too striking a resemblance not to admit such birds of the number; and though the bill, or even the toes should differ, yet the outlines of the figure, and the habits and dispositions being the same, these are sufficient to mark their place in the general group of nature.

The spoonbill is one of those birds which differs greatly from the crane, yet approaches this class more than any other. The body is more bulky from its height, and the bill is very differently formed from that of any other bird whatever. Yet still it is a comparatively tall bird: it feeds among waters; its toes are divided; and it seems to possess the natural dispositions of the crane. The European spoonbill is of about the bulk of a crane; but as the one is above four feet high, the other is not more than three feet three inches. The common colour of those of Europe is a dirty white; but those of America are of a beautiful rose colour, or a delightful crimson. Beauty of plumage seems to be the prerogative of all the birds of that continent; and we here see the most splendid tints bestowed on a bird whose figure is sufficient to destroy the effects of its colouring; for its bill is so oddly fashioned, and its eyes so stupidly staring, that its fine feathers only tend to add splendour to deformity. The bill is about seven inches long, and running out broad at the end, as its name justly serves to denote, it is there about an inch and a half wide. This strangely fashioned instrument in some is black; in others of a light grey; and in those of America it is of a red colour, like the rest of the body. All round the upper chap there runs a kind of rim, with which it covers that beneath; and as for the rest its cheeks and its throat are without feathers, and covered with a black skin.

A bird so oddly fashioned might be expected to possess some peculiar appetites; but the spoonbill seems to lead a life resembling all those of the crane kind; and nature, when she made the bill of this bird so very broad, seems rather to have sported with its form, than to aim at any final cause for which to adapt it.

The shoveler chiefly feeds upon frogs, toads, and serpents, of which, particularly at the Cape of Good Hope, they destroy great numbers. The inhabitants of that country hold them in as much esteem as the ancient Egyptians did their bird ibis; the shoveler runs tamely about their houses; and they are content with its society as an useful companion. They are never killed; and indeed they are good for nothing when they are dead, for the flesh is unfit to be eaten.

This bird breeds in Europe, in company with the heron, in high trees; and in a nest formed of the same materials. Willoughby tells us, that in a certain grove, at a village called Seven Huys, near Leyden, they build and breed yearly in great numbers. In this grove also the heron, the bittern, the cormorant, and the shag, have taken up their residence, and annually bring forth their young together. Here the crane kind seems to have formed their general rendezvous; and, as the inhabitants say, every sort of bird has its several quarter, where none but their own tribe are permitted to reside. Of this grove the peasants of the country make good profit. When the young ones are ripe, those that farm the grove, with a hook at the end of a long pole, catch hold of the bough on which the nest is built, and shake out the young ones; but sometimes the nest and all tumble down together.

The shoveler lays from three to five eggs, white and powdered with a few sanguine or pale spots. We sometimes see, in the cabinets of the curious, the bills of American shovelers, twice as big and as long as those of the common kind among us; but these birds have not yet made their way into Europe.

THE FLAMINGO.

The flamingo has the justest right to be placed among cranes; and though it happens to be web-footed, like birds of the goose kind, yet its height, figure, and appetites remove it from that groveling class of animals. With a longer neck and legs than any other of the crane kind, it seeks its food by wading among waters, and only differs from all of this tribe in the manner of seizing its prey; for as the heron makes use of its claws, the flamingo uses only its bill, which is strong and thick for the purpose, the claws being useless, as they are feeble, and webbed like those of water-fowl.

The flamingo is the most remarkable of all the crane kind, the tallest, bulkiest, and most beautiful. The body, which is of a beautiful scarlet, is no bigger than that of a swan; but its legs and neck are of such a length that when it stands erect it is six feet six inches high. Its wings extended are five feet six inches from tip to tip; and it is four feet eight inches from tip to tail. The head is round and small, with a large bill, seven inches long, partly red, partly black, and crooked like a bow. The legs and thighs, which are not much thicker than a man's finger, are about two feet eight inches high; and its neck near three feet long. The feet are not furnished with sharp claws, as in others of the crane kind; but feeble, and united by membranes, as in those of the goose. Of what use these membranes are does not appear, as the bird never swims, its legs and thighs being sufficient for bearing it into those depths where it seeks for prey.

This extraordinary bird is now chiefly found in America, but was once known on all the coasts of Europe. Its beauty, size, and delicacy of flesh, have been such temptations to destroy it, that it has long deserted the shores frequented by man, and taken refuge in countries as yet but thinly peopled. In those desert regions the flamingos live in a state of society, and under a better polity than any other of the feathered creation.

When the Europeans first came to America, and coasted down along the African shores, they found the flamingos on several shores, on either continent, gentle, and no way distrustful of mankind. They had long been used to security, in the extensive solitudes they had chosen; and knew no enemies but those they could well evade or oppose. The Negroes and the native Americans were possessed but of few destructive arts for killing them at a distance; and when the bird perceived the arrow, it well knew how to avoid it. But it was otherwise when the Europeans first came among them; the sailors, not considering that the dread of fire-arms was totally unknown in that part of the world, gave the flamingo the character of a foolish bird, that suffered itself to be approached and shot at. When the fowler had killed one, the rest of the flock, far from attempting to fly, only regarded the fall of their companion in a kind of fixed astonishment; another and another shot was discharged; and thus the fowler often levelled the whole flock, before one of them began to think of escaping.

But at present it is very different in that part of the world; and the flamingo is not only one of the scarcest, but one of the shyest birds in the world, and the most difficult of approach. They chiefly keep near the most deserted and inhospitable shores, near salt-water lakes and swampy islands. They come down to the banks of rivers by day; and often retire to the inland mountainous parts of the country at the approach of night. When seen by mariners in the day, they always appear drawn up in a long close line of two or three hundred together: and, as Dampier tells us, present at the distance of half a mile the representation of a long brick wall. Their rank, however, is broken when they seek for food; but they always appoint one of the number as a watch, whose only employment is to observe and give notice of danger, while the rest are feeding. When this centinel perceives the appearance of danger, he gives a loud scream, and instantly the whole cohort are upon the wing. They feed in silence; but upon this occasion all the flock are in one chorus, and fill the air with intolerable screamings.

From this it appears, that the flamingos are very difficult to be approached at present, and that they avoid mankind with the most cautious timidity; but it is not from any antipathy to man that they shun his society; for in some villages, as we are assured by Labat, along the coasts of Africa, the flamingos come in great numbers to make their residence among the natives. There they assemble by thousands, perched on the trees, within and about the village; and are so clamorous that the sound is heard near a mile off. The Negroes are fond of their company; and consider their society as a gift of Heaven, as a protection from evils. The French, who are admitted to this part of the coast, cannot, without some degree of discontent, see such a quantity of game untouched, and rendered useless by the superstition of the natives: they now and then privately shoot some of them when at a convenient distance from the village, and hide them in the long grass, if they perceive any of the Negroes approaching; for they would probably be ill-treated, if the blacks discovered their sacred birds thus treated.

Sometimes in their wild state they are shot by mariners, and their young, which run excessively fast, are often taken. Labat has frequently taken them with nets, properly extended round the places they breed in. When their long legs are entangled in the meshes, they are then unqualified to make their escape: but they still continue to combat with their destroyer; and the old ones, though seized by the head, will scratch with their claws, and these, though seemingly inoffensive, often do mischief. When fairly disengaged from the net, they nevertheless preserve their ferocity; refuse all nourishment; and peck and combat with their claws, at every opportunity. The fowler is, therefore, under the necessity of destroying them, when taken; as they would only pine and die, if left to themselves in captivity. The flesh of the old ones is black and hard; though, Dampier says, well-tasted: that of the young ones is still better. But, of all other delicacies, the flamingo's tongue is the most celebrated. 'A dish of flamingos' tongues,' says our author, 'is a feast for an emperor.' In fact, the Roman emperors considered them as the highest luxury; and we have an account of one of them, who procured fifteen hundred flamingos' tongues to be served up in a single dish. The tongue of this bird, which is so much sought after, is a good deal larger than that of any other bird whatever. The bill of the flamingo is like a large black box, of an irregular figure, and filled with a tongue which is black and gristly; but what peculiar flavour it may possess, we have not the power of saying. It is probable, that the beauty and scarcity of the bird, might be the first inducements to studious gluttony to fix upon its tongue as meat for the table.

These birds, as was said, always go in flocks together; and move in ranks, in the manner of cranes. They are sometimes seen, at day-break, flying down in great numbers from the mountains, and conducting each other with a trumpet cry, that sounds like the word *tococo*, whence the savages of Canada have given them the name. In their flight they appear to advantage; for they then seem of as bright a red as a burning coal. When they dispose themselves to feed, their cry ceases; and then they disperse over a whole marsh, in silence and assiduity. Their manner of feeding is singular: the bird thrusts down its head, so that the upper convex side of the bill only touches the ground; and in this position the animal appears, as it were, standing upon its head. In this manner it paddles and moves the bill about, and seizes whatever fish or insect happens to offer. For this purpose the upper chap is notched at the edges, so as to hold its prey with greater security.

Their time of breeding is according to the climate in which they reside: in North America they breed in our summer; on the other side the line they take the most favourable season of the year. They build their nests in extensive marshes, and where they fear not a surprise. The nest is not less curious than the animal that builds it: it is raised from the surface of the pool about a foot and a half, formed of mud scraped up together, and hardened by the sun, or the heat of the bird's body: it resembles a truncated cone, or one of the pots which we see placed on chimneys; on the top it is hollowed out to the shape of the bird, and in that cavity the female lays her eggs, without any lining but the well cemented mud that forms the sides of the building. She lays two eggs, and no more; and, as her legs are immoderately long, she straddles on the nest, while her legs hang down, one on each side, into the water.

The young ones are a long while before they are able to fly; but they run with amazing swiftness. They are sometimes caught; and, different from the old ones, suffer themselves to be carried home, and are tamed easily. In five or six days they become familiar, eat out of the hand, and drink a surprising quantity of sea-water. But though easily rendered domestic, they are not reared without great difficulty: for they generally pine away for want of their natural supplies, and die in a short time. While they are yet young, their colours are different from those lively tints they acquire with age. In their first year they are covered with a plumage of a white colour, mixed with grey; in the second, the whole body is white, with here and there a slight tint of scarlet; and the great covert feathers of the wings are black: the third year the bird acquires all its beauty; the plumage of the whole body is scarlet, except some of the feathers in the wings, that still retain their sable hue. Of these plumes, the savages make various ornaments; and the bird is sometimes skinned by the Europeans, to make muffs. But these have diminished in their price, since we have obtained the art of dying feathers of the brightest scarlet.

OF THE AVOSETTA, OR SCROOPER, AND THE CORRIRA, OR RUNNER.

The shape of the Avosetta's bill might incline the reader to wish for its history; but in that we are not able to indulge him. Natural historians have hitherto, like ambitious monarchs, shewn a greater fondness for extending their dominions, than cultivating what they possess. While labouring to add new varieties to their catalogues, they neglected to study the history of those already known.

The avosetta is chiefly found in Italy, and now and then comes to England. It is about the size of a pigeon, is a pretty upright bird, and has long legs for its size. But the most extraordinary part of its figure, and that by which it may be distinguished from all others of the feathered tribe, is the bill, which turns up like a hook, in an opposite direction to that of the hawk or the parrot. This bill is black, flat, sharp, and flexible at the end, and about three inches and a half long. From its being bare a long way above the knee, it appears that it lives and wades in the waters. It has a chirping, pert note, as we are told; but with its other habits we are entirely unacquainted. I have placed it, from its slender figure, among the cranes; although it is web-footed, like the duck. It is one of those birds of whose history we are yet in expectation.

To this bird of the crane kind, so little known, I will add another, still less known; the corrira, or runner, of Aldrovandus. All we are told is, that it has the longest legs of all the web-footed fowls, except the flamingo and avosetta; that the bill is straight, yellow and black at the ends; that the pupils of the eyes are surrounded with two circles, one of which is bay, the other white: near the belly, it is whitish; the tail, with two white feathers, black at the extremities: and the upper part of the body of the colour of rusty iron. Thus we must substitute dry description for instructive history; and employ words, to express those shadings of colour which the pencil alone can convey.

OF SMALL BIRDS OF THE CRANE KIND, WITH THE THIGHS PARTLY BARE OF FEATHERS.

As I have taken my distinctions rather from the general form and manners of birds, than from their minuter, though perhaps more precise discriminations, it will not be expected that I should here enter into a particular history of a numerous tribe of birds, whose manners and forms are so very much alike. Of many of them we have scarcely any account in our historians, but tedious descriptions of their dimensions, and the colour of their plumage; and of the rest, the history of one is so much that of all, that it is but the same account repeated to a most disgusting reiteration. I shall therefore place them into one general draught; in which the more eminent, or the most whimsical, will naturally stand forward on the canvas.

In this group we find an extensive tribe of native birds, with their varieties and affinities; and we might add a hundred others, of distant climates, of which we know little more than the colour and the name. In this list is exhibited the curlew, a bird of about the size of a duck, with a bill four inches long: the woodcock, about the size of a pigeon, with a bill three inches long: the godwit of the same size; the bill four inches: the green shank, longer legged; the bill two inches and a half: the red shank, differing in the colour of its feet from the former: the snipe, less by half, with a bill three inches. Then with shorter bills—the ruff, with a collar of feathers round the neck of the male: the knot, the sandpiper, the sanderling, the dunlin, the purre, and the stint. To conclude: with bills very short—The lapwing, the green plover, the grey plover, the dottrel, the turnstone, and the sea-lark. These, with their affinities, are properly natives or visitants of this country; and are dispersed along our shores, rivers, and watery grounds. Taking in the birds of this kind, belonging to other countries, the list would be widely extended; and the whole of this class, as described by Brisson, would amount to near a hundred.

All these birds possess many marks in common; though some have peculiarities that deserve regard. All these birds are bare of feathers above the knee, or above the heel, as some naturalists choose to express it. In fact, that part which I call the knee, if compared with the legs of mankind, is analogous to the heel: but, as it is commonly conceived otherwise, I have conformed to the general apprehension. I say, therefore, that all these birds are bare of feathers above the knee; and in some they are wanting half way up the thigh. The nudity in that part, is partly natural, and partly produced by all birds of this kind, habitually wading in water. The older the bird, the barer are its thighs; yet even the young ones have not the same downy covering reaching so low as the birds of any other class. Such a covering there would rather be prejudicial, as being continually liable to get wet in the water.

As these birds are usually employed rather in running than flying, and as their food lies entirely upon the ground, and not on trees, or in the air, so they run with great swiftness for their size, and the length of their legs assist their velocity. But as, in seeking their food, they are often obliged to change their station, so also are they equally swift of wing, and traverse immense tracts of country without much fatigue.

Some have thought, that a part of this class lived upon an oily slime, found in the bottoms of ditches and of weedy pools; they were thence termed by Willoughby, *mudsuckers*. But later discoveries have shown that, in these places, they hunt for the caterpillars and worms of insects. Hence we may generally assert, that all birds of this class live upon animals of one kind or another. The long-billed birds suck up worms and insects from the bottom; those furnished with shorter bills, pick up such insects as lie nearer the surface of the meadow, or among the sands on the sea-shore.

Thus the curlew, woodcock, and snipe, are ever seen in plashy brakes, and under covered hedges, assiduously employed in seeking insects in their worm state; and it seems, from their fatness, that they find a good supply. Nature, indeed, has furnished them with convenient instruments for procuring food. Their bills are made long for searching; but still more, they are endowed with an exquisite sensibility at the point, for feeling their provision. They are furnished with no less than three pair of nerves, equal almost to the optic nerves in thickness; which pass from the roof of the mouth, and run along the upper chap to the point.

Nor are those birds with shorter bills, and destitute of such convenient instruments, without a proper provision made for their subsistence. The lapwing, the sandpiper, and the redshank, run with surprising rapidity along the surface of the marsh, or the sea-shore, quarter their ground with great dexterity, and leave nothing of the insect kind that happens to lie on the surface. These are neither so fat nor so delicate as the former; as they are obliged to toil more for a subsistence, they are easily satisfied with whatever offers; and their flesh often contracts a relish from what has been their latest, or principal food.

Most of the birds formerly described have stated seasons for feeding and rest: the eagle kind prowl by day, and at evening repose; the owl by night, and keeps unseen in the day-time; but these birds of the crane kind seem at all hours employed; they are seldom at rest by day; and during the whole night season every meadow and marsh resounds with their calls to courtship or to food.

This seems to be the time when they least fear interruption from man; and though they fly at all times, yet at this season they appear more assiduously employed, both in providing for their present support, and continuing that of posterity. This is usually the season when the insidious fowler steals in upon their occupations, and fills the whole meadow with terror and destruction.

All of this kind live entirely in waters, and among watery places, and seem provided by nature with a warmth of constitution to fit them for that element. They reside by choice in the coldest climates: and as other birds migrate here in our summer, their migrations hither are mostly in the winter. Even those that reside among us the whole season retire in summer to the tops of our bleakest mountains; where they breed, and bring down their young when the cold weather sets in.

But most of them migrate, and retire to the polar regions; as those that remain behind in the mountains, and keep with us during summer, bear no proportion to the quantity which in winter haunt our marshes and low grounds. The snipe sometimes builds here; and the nest of the curlew is sometimes found in the plashes of our hills; but the number of these is very small; and it is most probable that they are only some stragglers, who, not having strength or courage sufficient for the voyage, take up from necessity their habitation here.

In general, during the summer, this whole class either choose the coldest countries to retire to, or the coldest and the moistest part of ours to breed in. The curlew, the woodcock, the snipe, the godwit, the grey plover, the green, and the long legged plover, the knot and the turnstone, are rather the guests than the natives of this island. They visit us in the beginning of winter, and forsake us in the spring. They then retire to the mountains of Sweden, Poland, Prussia, and Lapland, to breed. Our country, during the summer, becomes uninhabitable to them. The ground parched up by the heat; the springs dried away; and the vermicular insects already upon the wing; they have no means of subsisting. Their weak and delicately pointed bills are unfit to dig into a resisting soil; and their prey is departed, though they were able to reach its retreats. The coldest mountains of the north are a preferable habitation in our summer to them; the marshes there are never totally dried up; and the insects are in such abundance, that both above ground and underneath the country swarms with them. In such retreats, therefore, these birds would continue always; but that the frosts, when they set in, have the same effect upon the face of the landscape, as the heats of summer. Every brook is stiffened into ice; all the earth is congealed into one solid mass; and the birds are obliged to forsake a region where they can no longer find subsistence.

Such are our visitants. With regard to those which keep with us continually, and breed here, they are neither so delicate in their food, nor perhaps so warm in their constitutions. The lapwing, the ruff, the redshank, the sandpiper, the sea-pie, the Norfolk plover, and the sea-lark, breed in this country, and for the most part reside here. In summer they frequent such marshes as are not dried up in any part of the year; the Essex hundreds, and the fens of Lincolnshire. There, in solitudes formed by surrounding marshes, they breed and bring up their young. In winter they come down from their retreats, rendered uninhabitable by the flooding of the waters; and seek their food about our ditches and marshy meadow grounds. Yet even of this class all are wanderers upon some occasions; and take wing to the northern climates to breed and find subsistence. This happens when our summers are dry; and when the fenny countries are not sufficiently watered to defend their retreats.

But though this be the usual course of nature, with respect to these birds, they often break through the general habits of their kind; and as the lapwing, the ruff, and the sandpiper, are sometimes seen to alter their manners, and to migrate from hence, instead of continuing to breed here; so we often find the woodcock, snipe, and curlew reside with us during the whole season, and breed in different parts of the country. In Casewood, about two miles from Tunbridge, as Mr. Pennant assures us, some woodcocks are seen to breed annually. The young have been shot there in the beginning of August; and were as healthy and vigorous as they are with us in winter, though not so well tasted. On the Alps, and other high mountains, says Willoughby, the woodcock continues all summer; I myself have flushed them on the top of Mount Jura in June and July. The eggs are long, of a pale red colour, and stained with deeper spots and clouds. Nests of the curlew and snipe are frequently found; and some of these perhaps never entirely leave this island.

It is thus that the same habits are in some measure common to all; but in nestling, and bringing up their young, one method takes place universally. As they all run and feed upon the ground, so they are all found to nestle there. The number of eggs generally to be seen in every nest is from two to four; never under, seldom exceeding. The nest is made without any art; but the eggs are either laid in some little depression of the earth, or on a few bents and long grass, that scarcely preserve them from the moisture below. Yet such is the heat of their body, that their time of incubation is shorter than with any others of the same size. The magpie, for instance, takes twenty-one days to hatch its young; the lapwing takes but fourteen. Whether the animal oil, with which these animals abound, gives them this superior warmth, I cannot tell; but there is no doubt of their quick incubation.

In their seasons of courtship they pair as other birds; but not without violent contests between the males, for the choice of the female. The lapwing and the plover are often seen to fight among themselves; but there is one little bird of this tribe, called the *ruff*, that has got the epithet of the *fighter*, merely from its great perseverance and animosity on these occasions. In the beginning of spring, when these birds arrive among our marshes, they are observed to engage with desperate fury against each other; it is then that the fowlers, seeing them intent on mutual destruction, spread their nets over them, and take them in great numbers. Yet even in captivity their animosity continues: the people that fat them for sale are obliged to shut them up in close dark rooms; for if they let but little light in among them the turbulent prisoners fall to fighting with each other, and never cease till each has killed its antagonist, especially, says Willoughby, if any body stands by. A similar animosity, though in a less degree, prompts all this tribe; but when they have paired, and begun to lay, their contentions are over.

The place these birds chiefly choose to breed in is in some island surrounded with sedgy moors, where men seldom resort; and in such situations I have often seen the ground so strewed with eggs and nests, that one could scarce take a step without treading upon some of them. As soon as a stranger intrudes upon these retreats, the whole colony is up, and a hundred different screams are heard from every quarter. The arts of the lapwing, to allure men or dogs from her nest, are perfectly amusing. When she perceives the enemy approaching, she never waits till they arrive at her nest, but boldly runs to meet them; when she has come as near them as she dares to venture, she then rises with a loud screaming before them, seeming as if she was just flushed from hatching; while she is then probably a hundred yards from the nest. Thus she flies, with great clamour and anxiety, whining and screaming round the invaders, striking at them with her wings, and fluttering as if she were wounded. To add to the deceit she appears still more clamorous as more remote from the nest. If she sees them very near, she then seems to be quite unconcerned, and her cries cease, while her terrors are really augmented. If there be dogs, she flies heavily at a little distance before them, as if maimed; still vociferous and bold, but never offering to move towards the quarter where her treasure is deposited. The dog pursues, in hopes of seizing the parent, and thus actually loses the young; for the cunning bird, when she has thus drawn him off to a proper distance, then puts forth her powers, and leaves her astonished pursuer to gaze at the rapidity of her flight. The eggs of all these birds are highly valued by the luxurious; they are boiled hard, and served up without any further preparation.

As the young of this class are soon hatched, so when excluded they quickly arrive at maturity. They run about after the mother as soon as they leave the egg; and, being covered with a thick down, want little of that clutching which birds of the poultry kind, that follow the mother, always require. They come to their adult state long before winter; and then flock together till the breeding season returns, which for a while dissolves their society.

As the flesh of almost all these birds is in high estimation, so many methods have been contrived for taking them. That used in taking the ruff seems to be most advantageous; and it may not be amiss to describe it. The ruff, which is the name of the male, the reeve, that of the female, is taken in nets about forty yards long, and seven or eight feet high. These birds are chiefly found in Lincolnshire and the isle of Ely, where they come about the latter end of April, and disappear about Michaelmas. The male, which is known from all others of the kind by the great length of the feathers round his neck, is so various in his plumage, that it is said, no two ruffs were ever seen exactly of the same colour. The nets in which these are taken are supported by sticks, at an angle of near forty-five degrees, and placed either on dry ground, or in very shallow water, not remote from reeds; among these the fowler conceals himself, till the birds, enticed by a stale or stuffed bird, come under the nets; he then, by pulling a string, lets them fall, and they are taken: as are godwits, knots, and grey-plovers also in the same manner. When these birds are brought from under the net, they are not killed immediately, but fattened for the table, with bread and milk, hemp-seed, and sometimes boiled wheat; but if expedition be wanted, sugar is added, which will make them a lump of fat in a fortnight's time. They are kept, as observed before, in a dark room; and judgment is required in taking the proper time for killing them, when they are at the highest pitch of fatness; for, if that be neglected, the birds are apt to fall away. They are reckoned a great delicacy; they sell high; and are served up to table with the train, like woodcocks.

OF THE WATER-HEN, AND THE COOT.

Before we enter upon water-fowls, properly so called, two or three birds claim our attention, which seem to form the shade between the web-footed tribe and those of the crane kind. These partake rather of the form than the habits of the crane; and, though furnished with long legs and necks, rather swim than wade. They cannot properly be called web-footed; nor yet are they entirely destitute of membranes, which fringe their toes on each side, and adapt them for swimming. The birds in question are, the water-hen and the bald-coot.

These birds have too near an affinity, not to be ranked in the same description. They are shaped alike, their legs long, and thighs partly bare; their necks are proportionable, their wings short, their bills short and weak, their colour black, their foreheads bald and without feathers, and their habits are entirely the same. These naturalists have thought proper to range in different classes, from slight distinctions in their figure. The water-hen, weighs but fifteen ounces; the coot twenty-four. The bald part of the forehead in the coot is black; in the water-hen it is of a beautiful pink colour. The toes of the water-hen are edged with a straight membrane; those of the coot have it scolloped and broader.

The differences in the figure are but slight; and those in their manner of living still less. The history of the one will serve for both. As birds of the crane kind are furnished with long wings, and easily change place, the water-hen, whose wings are short, is obliged to reside near those places where her food lies: she cannot take those long journeys that most of the crane kind are seen to perform; compelled by her natural imperfections, as well perhaps as by inclination, she never leaves the side of the pond or the river in which she seeks for provision. Where the stream is selvaged with sedges, or the pond edged with shrubby trees, the water-hen is generally a resident: she seeks her food along the grassy banks, and often along the surface of the water. With Shakspeare's Edgar, she drinks the green mantle of the standing pool; or, at least, seems to prefer those places where it is seen. Whether she makes pond-weed her food, or hunts among it for water-insects, which are found there in great abundance, is not certain. I have seen them when pond-weed was taken out of their stomach. She builds her nest upon low trees and shrubs, of sticks and fibres by the water-side. Her eggs are sharp at one end, white, with a tincture of green, spotted with red. She lays twice or thrice in a summer; her young ones swim directly they leave the egg, pursue their parent, and imitate her manners. She rears, this way, two or three broods in a season: and when the young are grown up, she drives them off to shift for themselves.

The coot being a larger bird, it is always seen in larger streams, and more remote from mankind. The water-hen seems to prefer inhabited situations; she keeps near ponds, moats, and pools of water near gentlemen's houses; but the coot keeps in rivers, and among rushy margined lakes. It there makes a nest of such weeds as the stream supplies, and lays them among the reeds, floating on the surface, and rising and falling with the water. The reeds among which it is built keep it fast; so that it is seldom washed into the middle of the stream. But if this happens, which is sometimes the case, the bird sits in her nest, like a mariner in his boat, and steers with her legs her cargo into the nearest harbour: there, having attained her port, she continues to sit in great tranquillity, regardless of the impetuosity of the current; and though the water penetrates her nest, she hatches her eggs in that wet condition.

The water-hen never wanders; but the coot sometimes swims down the current, even to the sea. In this voyage these birds encounter a thousand dangers: as they cannot fly far, they are hunted by dogs and men; as they never leave the stream, they are attacked and destroyed by otters; they are preyed upon by kites and falcons; and they are taken in still greater numbers, in weirs made for catching fish; for these birds are led into the nets, while pursuing small fish and insects, which are their principal food. Thus Animated Nature affords a picture of universal invasion! Man destroys the otter, the otter destroys the coot, the coot feeds upon fish, and fish are universally the tyrants of each other!

To these birds, with long legs and finny toes, I shall add one species more, with short legs and finny toes: I mean the Grebe. The resemblance of this bird's appetites and manners to those of the web-footed class, might induce me to rank it among them; but as it resembles those above described, in the form of its toes, and bears some similitude in its manners also, I shall for once sacrifice method to brevity. The grebe is much larger than either of the former, and its plumage white and black: it differs also in the shortness of its legs, which are made for swimming, and not walking: in fact, they are from the knee upward hid in the belly of the bird, and have consequently little motion. By this mark, and by the scolloped fringe of the toes, may this bird be distinguished from all others.

As they are thus, from the shortness of their wings and legs, ill-formed for flying, and unfitted for walking, they seldom leave the water, and chiefly frequent those broad shallow pools where their faculty of swimming can be turned to advantage, in fishing and seeking their prey.

They are, in this country, seen to frequent the meres of Shropshire and Cheshire; where they breed among reeds and flags, in a floating nest, kept steady by the weeds of the margin. The female is said to be a careful nurse of its young, being observed to feed them most assiduously with small eels; and when the little brood is tired, the mother will carry them either on her back or under her wings. This bird preys upon fish, and is almost perpetually diving. It does not show much more than the head above water; and is difficult to be shot, as it darts down on the appearance of the least danger. It is never seen on land; and, though disturbed ever so often, will not leave that lake, where alone, by diving and swimming, it can find food and security. It is chiefly sought for the skin of its breast, the plumage of which is of a most beautiful silvery white, and as glossy as satin. This part is made into tippets; but the skins are out of season about February, losing their bright colour; and in breeding-time their breasts are bare.

OF WATER-FOWL IN GENERAL.

In settling the distinctions among the other classes of birds, there was some difficulty; one tribe encroached so nearly upon the nature and habitudes of another, that it was not easy to draw the line which kept them asunder: but in water-fowl Nature has marked them for us by a variety of indelible characters; so that it would be almost as unlikely to mistake a land-fowl for one adapted for living and swimming among the waters, as a fish for a bird.

The first great distinction in this class, appears in the toes, which are webbed together for swimming. Those who have remarked the feet or toes of a duck, will easily conceive how admirably they are formed for making way in the water. When men swim, they do not open the fingers, so as to let the fluid pass through them; but closing them together, present one broad surface to beat back the water, and thus push their bodies along. What man performs by art, Nature has supplied to water-fowl; and, by broad skins, has webbed their toes together, so that they expand two broad oars to the water; and thus, moving them alternately, with the greatest ease paddle along. We must observe also, that the toes are so contrived, that as they strike backward, their broadest hollow surface beats the water; but as they gather them in again, for a second blow, their front surface contracts, and does not impede the bird's progressive motion.

As their toes are webbed in the most convenient manner, so are their legs made fitly for swift progression in the water. The legs of all are short, except the three birds described in a former chapter; namely, the flamingo, the avosetta, and the corrira: all which, for that reason, I have thought proper to rank among the crane kind, as they make little use of their toes in swimming. Except these, all web-footed birds have short legs; and these strike, while they swim, with great facility.—Were the leg long, it would act like a lever whose prop is placed to a disadvantage; its motions would be slow, and the labour of moving it considerable. Therefore, the few birds whose webbed feet are long, never use them in swimming: the web at the bottom seems only of service as a broad base, to prevent them from sinking while they walk in the mud; but otherwise rather retards than advances their motion.

The shortness of the legs in the web-footed kinds, renders them as unfit for walking on land, as it qualifies them for swimming in their natural element. Their stay, therefore, upon land, is but short and transitory; and they seldom venture to breed far from the sides of those waters where they usually remain. In their breeding seasons, their young are brought up by the waterside; and they are covered with a warm down, to fit them for the coldness of their situation. The old ones, also, have a closer, warmer plumage than birds of any other class. It is of their feathers that our beds are composed; as they neither matt nor imbibe humidity, but are furnished with an animal oil that glazes their surface, and keeps each separate. But in some this animal-oil is too abundant; and though offensive from its smell, is serviceable for the purposes of household economy. The feathers, therefore, of all the penguin kind are useless for domestic purposes: as neither boiling nor bleaching can divest them of their oily rancidity. Indeed, the rancidity of all new feathers, of whatever water-fowl they be, is so disgusting, that our upholsterers give near double the price for old feathers that they afford for new; to be free from smell, they must all be lain upon for some time; and their usual method is to mix the new and the old together.

This quantity of oil, with which most water-fowl are supplied, contributes also to their warmth in the moist element where they reside. Their skin is generally lined with fat; so that with the warmth of the feathers externally, and this natural lining more internally, they are better defended against the changes or the inclemencies of the weather than any other class whatever.

As among land-birds there are some found fitted entirely for depredation, and others for an harmless method of subsisting upon vegetables, so also, among these birds there are tribes of plunderers that prey, not only upon fish, but sometimes upon water-fowl themselves. There are likewise more inoffensive tribes, that live upon insects and vegetables only. Some water-fowls subsist by making sudden stoops from above, to seize whatever fish comes near the surface; others again, not furnished with wings long enough to fit them for flight, take their prey by diving after it to the bottom.

From hence all water-fowl naturally fall into three distinctions. Those of the gull kind, that, with long legs and round bills, fly along the surface to seize their prey; those of the penguin kind, that, with round bills, legs hid in the abdomen, and short wings, dive after their prey: and, thirdly, those of the goose kind, with flat broad bills, that lead harmless lives, and chiefly subsist upon insects and vegetables.

These are not speculative distinctions, made up for the arrangement of a system, but are strongly and evidently marked by nature. The gull kind are active and rapacious; constantly, except when they breed, keeping upon the wing; fitted for a life of rapine, with sharp, straight bills for piercing, or hooked at the end for holding their fishy prey. In this class we may rank the albatross, cormorant, gannet or soland goose, shag, frigate-bird, great brown gull, and all the lesser tribe of gulls and sea-swallows.

The penguin kind, with appetites as voracious, bills as sharp, and equally eager for prey, are yet unqualified to obtain it by flight. Their wings are short, and their bodies large and heavy, so that they can neither run nor fly. But they are formed for diving in a peculiar manner. Their feet are placed so far backward, and their legs so hid in the abdomen, that the slightest stroke sends them head foremost to the bottom of the water. To this class we may refer the penguin, auk, skout, sea-turtle, bottle-nose, and loon.

The goose kind are easily known by their flat, broad bills, covered with a skin; and their manner of feeding, which is mostly upon vegetables. In this class we may place the swan, goose, duck, teal, widgeon, and all their varieties.

In describing the birds of these three classes I shall put the most remarkable of each class at the beginning of their respective tribes, and give their separate history; then having described the chiefs of the tribe, the more ordinary sorts will naturally fall in a body, and come under a general description, behind their leaders. But before I offer to pursue this arrangement, I must give the history of a bird, that from the singularity of its conformation seems allied to no species; and should therefore be separately described—I mean the pelican.

OF THE PELICAN.

The pelican of Africa is much larger in the body than a swan, and somewhat of the same shape and colour. Its four toes are all webbed together; and its neck, in some measure, resembles that of a swan; but that singularity in which it differs from all other birds, is in the bill and the great pouch underneath, which are wonderful, and demand a distinct description. This enormous bill is fifteen inches from the point to the opening of the mouth, which is a good way back, behind the eyes. At the base the bill is somewhat greenish, but varies towards the end, being of a reddish-blue. It is very thick in the beginning, but tapers off to the end, where it hooks downwards. The underchap is still more extraordinary; for to the lower edges of it hangs a bag, reaching the whole length of the bill to the neck, which is said to be capable of containing fifteen quarts of water. This bag the bird has a power of wrinkling up into the hollow of the under-chap; but by opening the bill, and putting one's hand down into the bag, it may be distended at pleasure. The skin of which it is formed will then be seen of a bluish ash-colour, with many fibres and veins running over its surface. It is not covered with feathers, but a short downy substance, as smooth and as soft as satin, is attached all along the under edges of the chap, to be fixed backward to the neck of the bird by proper ligaments, and reaches nearly half way down. When this bag is empty, it is not seen; but when the bird has fished with success, it is then incredible to what an extent it is often seen dilated. For the first thing the pelican does in fishing is to fill up the bag; and then it returns to digest its burthen at leisure. When the bill is opened to its widest extent a person may run his head into the bird's mouth, and conceal it in this monstrous pouch, thus adapted for singular purposes. Yet this is nothing to what Ruysch assures us, who avers, that a man has been seen to hide his whole leg, boot and all, in the monstrous jaws of one of these animals. At first appearance this would seem impossible, as the sides of the under chap, from which the bag depends, are not above an inch asunder when the bird's bill is first opened; but then they are capable of great separation; and it must necessarily be so, as the bird preys upon the largest fishes, and hides them by dozens in its pouch. Tertre affirms, that it will hide as many fish as will serve sixty hungry men for a meal.

Such is the formation of this extraordinary bird, which is a native of Africa and America. The pelican was once also known in Europe, particularly in Russia; but it seems to have deserted our coasts. This is the bird of which so many fabulous accounts have been propagated; such as its feeding its young with its own blood, and its carrying a provision of water for them in its great reservoir in the desert. The absurdity of the first answers itself; and as for the latter, the pelican uses its bag for different purposes than that of filling it with water.

Its amazing pouch may be considered as analogous to the crop in other birds, with this difference, that as theirs lies at the bottom of the gullet, so this is placed at the top. Thus, as pigeons and other birds macerate their food for their young in their crops, and then supply them, so the pelican supplies its young by a more ready contrivance, and macerates their food in its bill, or stores it for its own particular sustenance.

The ancients gave this bird admirable qualities and parental affections; struck perhaps with its extraordinary figure, they were willing to supply it with as extraordinary appetites; and having found it with a large reservoir, they were pleased with turning it to the most tender and parental uses. But the truth is, the pelican is a heavy, sluggish, voracious bird, and ill fitted to take those flights, or to make those cautious provisions for a distant time, which have been told of them. Father Labat, who seems to have studied their manners with great precision, has given us a minute history of this bird, as found in America; and from him I shall borrow mine.

The pelican, says Labat, has strong wings, furnished with thick plumage of an ash-colour, as are the rest of the feathers over the whole body. Its eyes are small, when compared to the size of its head; there is a sadness in its countenance, and its whole air is melancholy. It is as dull and reluctant in its motions, as the flamingo is sprightly and active. It is slow of flight; and when it rises to fly, performs it with difficulty and labour. Nothing, it seems, but the spur of necessity could make these birds change their situation, or induce them to ascend into the air; but they must either starve or fly.

They are torpid and inactive to the last degree, so that nothing can exceed their indolence but their gluttony; it is only from the stimulations of hunger that they are excited to labour; for otherwise they would continue always in fixed repose. When they have raised themselves about thirty or forty feet above the surface of the sea, they turn their head with one eye downwards, and continue to fly in that posture. As soon as they perceive a fish sufficiently near the surface, they dart down upon it with the swiftness of an arrow, seize it with unerring certainty, and store it up in their pouch. They then rise again, though not without great labour, and continue hovering and fishing, with their head on one side as before.

This work they continue with great effort and industry till their bag is full, and then fly to land to devour and digest at leisure the fruits of their industry. But this, it would appear, they are not long in performing; for towards night they have another hungry call; and they again reluctantly go to labour. At night, when their fishing is over, and the toil of the day crowned with success, these lazy birds retire a little way from the shore; and though with the webbed feet and clumsy figure of a goose, they will be contented to perch no where but upon trees among the light and airy tenants of the forest. There they repose for the night; and often spend a great part of the day, except such times as they are fishing, sitting in dismal solemnity, and, as it would seem, half asleep. Their attitude is, with the head resting upon their great bag, and that resting upon their breast. There they remain without motion, or once changing their position, till the calls of hunger break their repose, and they find it indispensably necessary to fill their magazine for a fresh meal. Thus their life is spent between sleeping and eating; and our author adds, they are as foul as they are voracious, as they are every moment voiding excrements in heaps.

The same indolent habits seem to attend them even in preparing for incubation, and defending their young when excluded. The female makes no preparation for her nest, nor seems to choose any place in preference to lay in; but drops her eggs on the bare ground to the number of five or six, and there continues to hatch them. Attached to the place, without any desire of defending her eggs or young, she sits and suffers them to be taken from her. Now and then she just ventures to peck, or cry out when a person offers to beat her off.

She feeds her young with fish macerated for some time in her bag; and when they cry, flies off for a new supply. Labat tells us, that he took two of these when very young, and tied them by a leg to a post stuck into the ground, where he had the pleasure of seeing the old one for several days come to feed them, remaining with them the greatest part of the day, and spending the night on the branch of a tree that hung over them. By these means they were all three become so familiar, that they suffered themselves to be handled; and the young ones accepted whatever fish he offered them. These they always put first into their bag, and then swallowed at their leisure.

But they are disagreeable and useless domestics; their gluttony can scarcely be satisfied; their flesh smells very rancid, and tastes a thousand times worse than it smells. The native Americans kill vast numbers; not to eat, for they are not even fit for the banquet of a savage; but to convert their large bags into purses and tobacco-pouches. They bestow no small pains in dressing the skin with salt and ashes, rubbing it well with oil, and then forming it to their purpose. It thus becomes so soft and pliant, that the Spanish women sometimes adorn it with gold and embroidery to make work-bags of.

Yet, with all the seeming hebetude of this bird, it is not incapable of instruction in a domestic state. Father Raymond assures us, that he has seen one so tame and well educated among the native Americans, that it would go off in the morning at the word of command, and return before night to its master, with its paunch distended with plunder; a part of which the savages would make it disgorge, and a part they would permit it to reserve for itself.

'The Pelican,' as Faber relates, 'is not destitute of other qualifications. One of those which was brought alive to the Duke of Bavaria's court, where it lived forty years, seemed to be possessed of very uncommon sensations. It was much delighted in the company and conversation of men, and in music both vocal and instrumental: for it would willingly stand,' says he, 'by those that sung or sounded the trumpet; and stretching out its head, and turning its ear to the music, listened very attentively to its harmony, though its own voice was little pleasanter than the braying of an ass.' Gesner tells us that the Emperor Maximilian had a tame pelican which lived for above eighty years, and that always attended his army on their march. It was one of the largest of the kind, and had a daily allowance by the Emperor's orders. As another proof of the great age to which the pelican lives. Aldrovandus makes mention of one of these birds that was kept several years at Mechlin, and was verily believed to be fifty years old.—We often see these birds at our shows about town.

OF THE ALBATROSS, THE FIRST OF THE GULL KIND.

Though this is one of the largest and most formidable birds of Africa and America, we have but few accounts to enlighten us in its history. The figure of the bird is thus described by Edwards: 'The body is rather larger than that of the pelican; and its wings, when extended, ten feet from tip to tip. The bill, which is six inches long, is yellowish, and terminates in a crooked point. The top of the head is of a bright brown; the back is of a dirty deep spotted brown; and the belly and under the wing is white; the toes, which are webbed are of a flesh colour.'

Such are the principal traits in this bird's figure: but these lead us a very short way in its history; and our naturalists say nothing more. However, I am apt to believe this bird to be the same with that described by Wicquefort, under the title of the Alcatraz; its size, colours, and prey incline me to think so. He describes it as a kind of great gull, as large in the body as a goose, of a brown colour, with a long bill, and living upon fish, of which they kill great numbers.

This bird is an inhabitant of the tropical climates, and beyond them as far as the Straits of Magellan in the South Seas. It is one of the most fierce and formidable of the aquatic tribe, not only living upon fish, but also such small water-fowl as it can take by surprise. It preys, as all the gull kind do, upon the wing; and chiefly pursues the flying-fish, that are forced from the sea by the dolphins. The ocean in that part of the world presents a very different appearance from the seas with which we are surrounded. In our seas we see nothing but a dreary expanse, ruffled by winds, and seemingly forsaken by every class of Animated Nature. But the tropical seas, and the distant south latitudes beyond them, are all alive with birds and fishes, pursuing and pursued. Every various species of the gull kind are there seen hovering on the wing, a thousand miles from the shore. The flying fish are every moment rising to escape from their pursuers of the deep, only to encounter equal dangers in the air. Just as they rise the dolphin is seen to dart after them, but generally in vain; the gull has more frequent success, and often takes them at their rise; while the albatross pursues the gull, and obliges it to relinquish its prey: so that the whole horizon presents but one living picture of rapacity and evasion.

Though this bird be one of the most formidable tyrants of the deep, there are some associates which even tyrants themselves form, to which they are induced either by caprice or necessity. The albatross seems to have a peculiar affection for the penguin, and a pleasure in its society. They are always seen to choose the same places of breeding; some distant, uninhabited island, where the ground slants to the sea, as the penguin is not formed either for flying or climbing. In such places their nests are seen together, as if they stood in need of mutual assistance and protection. Captain Hunt, who for some time commanded at our settlement upon Falkland Islands, assures me, that he was often amazed at the union preserved between these birds, and the regularity with which they built together. In that bleak and desolate spot, where the birds had long continued undisturbed possessors, and no way dreaded the encroachment of men, they seemed to make their abode as comfortable as they expected it to be lasting. They were seen to build with great uniformity; their nests covering fields by thousands, and resembling a regular plantation. In the middle, on high, the albatross raised its nests, on heath, sticks, and long grass, about two feet above the surface: round this the penguins made their lower settlements, rather in holes in the ground, and most usually eight penguins to one albatross. Nothing is a stronger proof of Mr. Buffon's fine observation, that the presence of man not only destroys the society of meaner animals, but their instincts also. These nests are now, I am told, totally destroyed; the society is broke up; and the albatross and penguin have gone to breed upon more desert shores, in greater security.

THE CORMORANT.

This bird is about the size of a large Muscovy duck, and may be distinguished from all other birds of this kind by its four toes being united by membranes together; and by the middle toe being toothed or notched, like a saw, to assist in holding its fishy prey. The head and neck are of a sooty blackness; and the body thick and heavy, more inclining in figure to that of the goose than the gull. The bill is straight, till near the end, where the upper chap bends into a hook.

Notwithstanding the seeming heaviness of its make, there are few birds more powerfully predaceous. When winter approaches, they disperse along the sea-shore, and ascend up the mouths of fresh-water rivers, carrying destruction to all the finny tribe. They are remarkably voracious, and have a sudden digestion. Their appetite is for ever craving, and never satisfied. This gnawing sensation may probably be increased by the great quantity of small worms that fill their intestines, and which their gluttony contributes to engender.

Thus formed with gross appetites, this unclean bird has the most rank and disagreeable smell, and, when in its most healthful state, is more fœtid than even carrion. Its form, says an ingenious writer, is disagreeable; its voice hoarse and croaking; and all its qualities obscene. No wonder then that Milton should make Satan personate this bird, when he sent him upon the basest purposes, to survey with pain the beauties of Paradise, and to sit devising death on the tree of life.

Indeed, this bird seems to be of a multiform nature; and whatever fish are to be found, watches their migrations. It is seen as well by land as sea; it fishes in fresh-water lakes, as well as in the depths of the ocean; it builds in the cliffs of rocks, as well as on trees; and preys not only in the day-time, but by night.

Its indefatigable nature, and great power in catching fish, were probably the motives that induced some nations to breed this bird up tame, for the purposes of fishing; and Willoughby assures us, it was once used in England for that purpose. The description of their manner of fishing is thus delivered by Faber: ‘When they carry them out of the rooms where they are kept to the fish-pools, they hoodwink them, that they may not be frighted by the way. When they are come to the river they take off their hoods; and having tied a leather thong round the lower part of their necks, that they may not swallow down the fish they catch, they throw them into the river. They presently dive under water; and there for a long time with wonderful swiftness pursue the fish; and when they have caught them, rise to the top of the water, and pressing the fish lightly with their bills, swallow them; till each bird hath, after this manner, devoured five or six fishes. Then their keepers call them to the fist, to which they readily fly; and, one after another, vomit up all their fish, a little bruised with the first nip given in catching them. When they have done fishing, setting the birds on some high place, they loose the string from their necks, leaving the passage to the stomach free and open; and, for their reward they throw them part of their prey; to each one or two fishes, which they will catch most dexterously, as they are falling in the air.’

At present, the cormorant is trained up in every part of China for the same purpose, where there are many lakes and canals. ‘To this end,’ says Le Comte, ‘they are educated as men rear up spaniels or hawks, and one man can easily manage a hundred. The fisher carries them out into the lake, perched on the gunnel of his boat, where they continue tranquil, and expecting his orders with patience. When arrived at the proper place, at the first signal given, each flies a different way to fulfil the task assigned it. It is very pleasant, on this occasion, to behold with what sagacity they portion out the lake or the canal where they are upon duty. They hunt about, they plunge, they rise an hundred times to the surface, until they have at last found their prey. They then seize it with their beak by the middle, and carry it without fail to their master. When the fish is too large, they then give each other mutual assistance: one seizes it by the head, the other by the tail, and in this manner carry it to the boat together. There the boat-man stretches out one of his long oars, on which they perch, and being delivered of their burden, they fly off to pursue their sport. When they are wearied, he lets them rest for a while; but they are never fed till their work is over. In this manner they supply a very plentiful table; but still their natural gluttony cannot be reclaimed even by education. They have always, while they fish, the same string fastened round their throats, to prevent them from devouring their prey, as otherwise they would at once satiate themselves, and discontinue their pursuit the moment they had filled their bellies.’

As for the rest, the cormorant is the best fisher of all birds; and though fat and heavy with the quantity it devours, is nevertheless generally upon the wing. The great activity with which it pursues, and from a vast height drops down to dive after its prey, offers one of the most amusing spectacles to those who stand upon a cliff on the shore. This large bird is seldom seen in the air, but where there are fish below; but then they must be near the surface, before it will venture to souse upon them. If they are at a depth beyond what the impetus of its flight makes the cormorant capable of diving to, they certainly escape him; for this bird cannot move so fast under water as the fish can swim. Yet it seldom makes an unsuccessful dip; and is often seen rising heavily, with a fish larger than it can readily devour. It sometimes also happens, that the cormorant has caught the fish by the tail: and consequently the fins prevent its being easily swallowed in that position. In this case the bird is seen to toss its prey above its head, and dexterously to catch it when descending, by the proper end, and so swallow it with ease.

OF THE GANNET OR SOLAND GOOSE.

The gannet is of the size of a tame goose, but its wings much longer, being six feet over. The bill is six inches long, straight almost to the point, where it inclines down, and the sides are irregularly jagged, that it may hold its prey with greater security. It differs from the cormorant in size, being larger; and its colour, which is chiefly white; and by its having no nostrils, but in their place a long furrow reaching almost to the end of the bill. From the corner of the mouth is a narrow slip of black bare skin, that extends to the hind part of the head; beneath the skin is another, that, like the pouch of the pelican, is dilatable, and of size sufficient to contain five or six entire herrings, which in the breeding season it carries at once to its mate or its young.

These birds, which subsist upon fish, resort to those uninhabited islands where their food is found in plenty, and men seldom go to disturb them. The islands to the north of Scotland, the Skelig islands of the coast of Kerry, in Ireland, and those that lie in the north sea off Norway, abound with them. But it is on the Bass island, in the Firth of Edinburgh, where they are seen in the greatest abundance. ‘There is a small island,’ says the celebrated Harvey, ‘called the Bass, not more than a mile in circumference. The surface is almost wholly covered, during the months of May and June, with their nests, their eggs, and young. It is scarcely possible to walk without treading on them; the flocks of birds upon the wing are so numerous as to darken the air, like a cloud; and their noise is such that a person cannot, without difficulty, be heard by the person next to him. When one looks down upon the sea from the precipice, its whole surface seems covered with infinite numbers of birds of different kinds, swimming and pursuing their prey. If, in sailing round the island, one surveys its hanging cliffs, in every crag, or fissure of the broken rocks, may be seen innumerable birds, of various sorts and sizes, more than the stars of heaven, when viewed in a serene night. If they are viewed at a distance, either receding, or in their approach to the island, they seem like one vast swarm of bees.’

They are not less frequent upon the rocks of St. Kilda. Martin assures us, that the inhabitants of that small island consume annually near twenty-three thousand young birds of this species, beside an amazing quantity of their eggs. On these they chiefly subsist throughout the year; and from the number of these visitants make an estimate of their plenty for the season. They preserve both eggs and fowls in small pyramidal stone buildings, covering them with turf-ashes, to prevent the evaporation of their moisture.

The gannet is a bird of passage. In winter it seeks the more southern coasts of Cornwall, hovering over the shoals of herrings and pilchards that then come down from the northern seas; its first appearance in the northern islands is in the beginning of spring; and it continues to breed till the end of summer. But in general its motions are determined by the migrations of the immense shoal of herrings that come pouring down at that season through the British Channel, and supply all Europe, as well as this bird, with their spoil. The gannet attends the shoal in their passage, keeps with them in their circuit round our island, and shares with our fishermen this exhaustless banquet. As it is strong of wing it never comes near the land; but is constant to its prey. Wherever the gannet is seen, it is sure to announce to the fishermen the arrival of the finny tribe; they prepare their nets, and take the herrings by thousands at a draught; while the gannet, who came to give the first information, comes, and often snatches its prey from the fisherman, even in his boat. While the fishing season continues, the gannets are busily employed; but when the pilchards disappear from our coasts, the gannet takes its leave, to keep them company.

The cormorant has been remarked for the quickness of his sight; yet in this the gannet seems to exceed him. It is possessed of a transparent membrane under the eyelid, with which it covers the whole eye at pleasure, without obscuring the sight in the smallest degree. This seems a necessary provision for the security of the eyes of so weighty a creature, whose method of taking prey, like that of the cormorant, is by darting headlong down from a height of a hundred feet and more into the water to seize it. These birds are sometimes taken at sea, by fastening a pilchard to a board, which they leave floating. The gannet instantly pounces down from above upon the board, and is killed or maimed by the shock of a body where it expected no resistance.

These birds breed but once a year, and lay but one egg, which being taken away, they lay another; if that is also taken, then a third; but never more for that season. Their egg is white, and rather less than that of the common goose; and their nest large, composed of such substances as are found floating on the surface of the sea. The young birds, during the first year, differ in colour from the old ones; being dusky, speckled with triangular white spots; and resembling the colours of the speckled diver.

The Bass island, where they chiefly breed, belongs to one proprietor; so that care is taken never to fright away the birds when laying, or to shoot them upon the wing. By that means they are so confident as to alight and feed their young ones close beside you. They feed only upon fish, as was observed; yet the young gannet is counted a great dainty by the Scots, and sold dear; so that the lord of the islet makes a considerable profit by the sale.

OF SMALLER GULLS AND PETRELS.

Having described the manners of the great ones of this tribe, those of the smaller kinds may be easily inferred. They resemble the more powerful in their appetites for prey, but have not such certain methods of obtaining it. In general the industry of this tribe, and their audacity, increase in proportion to their imbecility; the great gulls live at a remote distance from man; the smaller are obliged to reside wherever they can take their prey; and to come into populous places, when solitude can no longer grant them a supply. In this class we may place the gull, properly so called, of which there are above twenty different kinds; the petrel, of which there are three; and the sea-swallow, of which there are as many. The gulls may be distinguished by an angular knob on the lower chap; the petrels by their wanting this knob; and the sea-swallow by their bills, which are straight, slender, and sharp-pointed. But they all agree in their appetites and places of abode.

The gull and its varieties are well known throughout the kingdom. It is seen with a slow-sailing flight, hovering over rivers to prey upon the smaller fish; it follows the ploughman in fallow fields to pick up insects; and when living animal food does not offer, it has been known to eat carrion. Gulls are found in great plenty in every place; but it is chiefly round our boldest rockiest shores that they are seen in the greatest abundance; it is there that the gull breeds and brings up its young; it is there that millions of them are heard screaming with discordant notes for months together.

Those who have been much upon our coasts know that there are two different kinds of shores; that which slants down to the water with a gentle declivity, and that which rises with a precipitate boldness, that seems set as a bulwark to repel the force of the deeps. It is to such shores as these that the tribe of the gull kind resort, as the rocks offer them a retreat for their young, and the sea a supply. In the cavities of these rocks, of which the shore is composed, the vast variety of sea-fowls retire to breed in safety. The waves beneath, that continually beat at the base, often wear the shore into an impending boldness; so that it seems to jut out over the water, while the raging of the sea makes the place inaccessible from below. These are the situations to which sea-fowl resort, and bring up their young in security.

Those who have never observed our boldest coasts have no idea of their tremendous sublimity. The boasted works of art, the highest towers, and the noblest domes, are but ant-hills when put in comparison; the single cavity of a rock often exhibits a coping higher than the cieling of a Gothic cathedral. The face of the shore offers to the view a wall of massive stone, ten times higher than our tallest steeples. What should we think of a precipice three quarters of a mile in height; and yet the rocks of St. Kilda are still higher! what must be our awe to approach the edge of that impending height, and to look down on the unfathomable vacuity below; to ponder on the terrors of falling to the bottom, where the waves that swell like mountains are scarcely seen to curl on the surface, and the roar of an ocean a thousand leagues broad appears softer than the murmur of a brook! In these formidable mansions myriads of sea-fowls are for ever seen sporting, flying in security down the depth, half a mile beneath the feet of the spectator. The crow and the chough avoid those precipices; they choose smaller heights, where they are less exposed to the tempest; it is the cormorant, the gannet, the tarrock, and the terne, that venture to these retreats, and claim an undisturbed possession. To the spectator from above, those birds, though some of them are larger than an eagle, seem scarcely the size of a swallow; and their loudest screaming is hardly perceptible.

But the generality of our shores are not so formidable. Though they may rise two hundred fathoms above the surface, yet it often happens that the water forsakes the shore at the departure of the tide, and leaves a noble and delightful walk for curiosity on the beach. Not to mention the variety of shells with which the sand is strewed, the lofty rocks that hang over the spectator's head, and that seem but just kept from falling, produce in him no unpleasing gloom. If to this be added the fluttering, the screaming, and the pursuits of myriads of water-birds, all either intent on the duties of incubation, or roused at the presence of a stranger, nothing can compose a scene of more peculiar solemnity. To walk along the shore, when the tide is departed, or to sit in the hollow of a rock, when it is come in, attentive to the various sounds that gather on every side, above and below, may raise the mind to its highest and noblest exertions. The solemn roar of the waves swelling into, and subsiding from the vast caverns beneath, the piercing note of the gull, the frequent chatter of the guillemot, the loud note of the hawk, the scream of the heron, and the hoarse periodical croaking of the cormorant, all unite to furnish the grandeur of the scene, and turn the mind to HIM who is the essence of all sublimity.

Yet it often happens that the contemplation of a sea-shore produces ideas of an humbler kind, yet still not unpleasing. The various arts of these birds to seize their prey, and to elude their pursuers, their society among each other, and their tenderness and care of their young, produce gentler sensations. It is ridiculous now and then to see their various ways of imposing upon each other. It is common enough, for instance, with the arctic gull, to pursue the lesser gulls so long, that they drop their excrements through fear, which the hungry hunter quickly gobbles up before it ever reaches the water. In breeding they have frequent contests; one bird who has no nest of her own attempts to dispossess another. This often happens among all the gull kind: and I have seen the poor bird, thus displaced by her more powerful invader, sit near the nest in pensive discontent, while the other seemed comfortable in her new habitation. Yet this place of pre-eminence is not easily obtained; for the instant the invader goes to snatch a momentary sustenance, the other enters upon her own, and always ventures another battle before she relinquishes her claim. The contemplation of a cliff thus covered with hatching-birds, affords an agreeable entertainment; and as they sit upon the ledges of the rocks, one above another, with their white breasts forward, the whole groupe has not unaptly been compared to an apothecary's shop.

These birds, like all others of the rapacious kind, lay but few eggs; and hence in many places, their number is daily seen to diminish. The lessening of so many rapacious birds may, at first sight, appear a benefit to mankind; but when we consider how many of the natives of our islands are sustained by their flesh, either fresh or salted, we shall find no satisfaction in thinking that these poor people may in time lose their chief support. The gull, in general, as was said, builds on the ledges of rocks, and lays from one egg to three, in a nest formed of long grass and sea-weed. Most of the kind are fishy tasted, with black stringy flesh; yet the young ones are better food; and of these, with several other birds of the penguin kind, the poor inhabitants of our northern islands make their wretched banquets. They have been long used to no other food; and even salted gull can be relished by those who know no better. Almost all delicacy is a relative thing; and the man who repines at the luxuries of a well-served table, starves not for want, but comparison. The luxuries of the poor are coarse to us, yet still they are luxuries to those ignorant of better; and it is probable enough that a Kilda or a Feroe man may be found to exist, outdoing Apicius himself, in the pleasures of the table. Indeed, if it be true that such meat as is the most dangerously earned, is the sweetest, no man can dine so luxuriously as these, as none venture so hardily in the pursuit of a dinner. In Jacobson's History of the Feroe Islands, we have an account of the method in which those birds are taken; and I give it in his own simple manner.

'It cannot be expressed with what pains and danger they take these birds in those high, steep cliffs, whereof many are two hundred fathoms high. But there are men apt by nature, and fit for the work, who take them usually in two manners: they either climb from below into these high promontories, that are as steep as a wall; or they let themselves down with a rope from above. When they climb from below, they have a pole five or six ells long, with an iron hook at the end, which they that are below in the boat, or on the cliff, fasten to the man's girdle, helping him up thus to the highest place where he can get footing; afterwards they also help up another man; and thus several climb up as high as possibly they can; and, where they find difficulty, they help each other up, by thrusting one another up with their poles. When the first hath taken footing, he draws the other up to him, by the rope fastened to his waist; and so they proceed till they come to the place where the birds build. They there go about as well as they can, in those dangerous places; the one holding the rope at one end, and fixing himself to the rock; the other going at the other end from place to place. If it should happen that he chanceth to fall, the other that stands firm keeps him up, and helps him up again. But if he passeth safe, he likewise fastens himself till the other has passed the same dangerous place also. Thus they go about the cliffs after birds as they please. It often happeneth, however, (the more is the pity) that when one doth not stand fast enough, or is not sufficiently strong to hold up the other in his fall, that they both fall down and are killed. In this manner some do perish every year.'

Mr. Peter Clanson, in his description of Norway, writes, that there was anciently a law in that country, that whosoever climbed so on the cliffs, that he fell down and died, if the body was found, before burial his next kinsman should go the same way; but if he durst not, or could not, do it, the dead body was not then to be buried in sanctified earth, as the person was too full of temerity, and his own destroyer.

'When the fowlers are come, in the manner aforesaid, to the birds within the cliffs, where people seldom come, the birds are so tame, that they take them with their hands; for they will not readily leave their young. But when they are wild, they cast a net, with which they are provided, over them, and entangle them therein. In the mean time, there lieth a boat beneath in the sea wherein they cast the birds killed; and, in this manner, they can in a short time, fill a boat with fowl. When it is pretty fair weather, and there is good fowling, the fowlers stay in the cliff seven or eight days together; for there are here and there holes in the rocks, where they can safely rest; and they have meat let down to them with a line from the top of the mountain. In the mean time some go every day to them, to fetch home what they have taken.

'Some rocks are so difficult, that they can in no manner get unto them from below; wherefore they seek to come down thereunto from above. For this purpose they have a rope eighty or a hundred fathoms long, made of hemp, and three fingers thick. The fowler maketh the end of this fast about his waist, and between his legs, so that he can sit thereon; and is thus let down, with the fowling-staff in his hand. Six men hold by the rope, and let him easily down, laying a piece of wood on the brink of the rock, upon which the rope glideth, that it may not be worn to pieces by the hard and rough edge of the stone. They have, besides, another line that is fastened to the fowler's body; on which he pulleth, to give them notice how they should let down the great rope, either lower or higher; or to hold still, that he may stay in the place whereunto he is come. Here the man is in great danger, because of the stones that are loosened from the cliff, by the swinging of the rope, and he cannot avoid them. To remedy this, in some meăsure, he hath usually on his head a seaman's thick and shaggy cap, which defends him from the blows of the stones, if they be not too big; and then it costeth him his life: nevērtheless, they continually put themselves in that danger, for the wretched body's food sake, hoping in God's mercy and protection, unto which the greatest part of them do devoutly recommend themselves when they go to work: otherwise, they say, there is no other great danger in it, except that it is a toilsome and artificial labour; for he that hath not learned to be so let down, and is not used thereto, is turned about with the rope, so that he soon groweth giddy, and can do nothing; but he that hath learned the art, considers it as a sport, swings himself on the rope, sets his feet against the rock, casts himself some fathoms from thence, and shoots himself to what place he will: he knows where the birds are, he understands how to sit on the line in the air, and how to hold the fowling-staff in his hand; striking therewith the birds that come or fly away: and when there are holes in the rocks, and it stretches itself out, making underneath as a cieling under which the birds are, he knoweth how to shoot himself in among them, and there take firm footing. There, when he is in these holes, he maketh himself loose of the rope, which he fastens to a crag of the rock, that it may not slip from him to the outside of the cliff. He then goes about in the rock, taking the fowl, either with his hands or the fowling-staff. Thus, when he hath killed as many birds as he thinks fit, he ties them in a bundle, and fastens them to a little rope, giving a sign, by pulling, that they should draw them up. When he has wrought thus the whole day, and desires to get up again, he sitteth once more upon the great rope, giving a new sign that they should pull him up; or else he worketh himself up, climbing along the rope, with his girdle full of birds. It is also usual, where there are not folks enough to hold the great rope, for the fowler to drive a post sloping into the earth, and to make a rope fast thereto, by which he lets himself down without any body's help, to work in the manner aforesaid. Some rocks are so formed that the person can go into their cavities by land.

'These manners are more terrible and dangerous to see than to describe; especially if one considers the steepness and height of the rocks, it seems impossible for a man to approach them, much less to climb or descend. In some places the fowlers are seen climbing where they can only fasten the ends of their toes and fingers; not shunning such places, though there be a hundred fathom between them and the sea. It is a dear meat for these poor people, for which they must venture their lives; and many, after long venturing, do at last perish therein.

'When the fowl is brought home, a part thereof is eaten fresh; another part, when there is much taken, being hung up for winter provision. The feathers are gathered to make merchandize of, for other expences. The inhabitants get a great many of these fowls, as God giveth his blessing and fit weather. When it is dark and hazy they take most; for then the birds stay in the rocks: but in clear weather and hot sunshine they seek the sea. When they prepare to depart for the season, they keep themselves most there, sitting on the cliffs towards the sea-side, where people get at them sometimes with boats, and take them with fowling-staves.'

Such is the account of this historian; but we are not to suppose that all the birds caught in this manner are of the gull kind; on the contrary, numbers of them are of the penguin kind; auks, puffins, and guillemots. These all come, once a season, to breed in these recesses; and retire in winter to fish in more southern climates.

OF THE PENGUIN KIND: AND FIRST, OF THE GREAT MAGELLANIC PENGUIN.

The gulls are long-winged, swift flyers, that hover over the most extensive seas, and dart down upon such fish as approach too near the surface. The penguin kind are but ill fitted for flight, and still less for walking. Every body must have seen the awkward manner in which a duck, either wild or tame, attempts to change place; they must recollect with what softness and ease a gull or a kite waves its pinions, and with what a coil and flutter the duck attempts to move them; how many strokes it gives in order to gather a little air; and even when it is thus raised, how soon it is fatigued with its exertions, and obliged to take rest again. But the duck is not, in its natural state, half so unwieldy an animal as the whole tribe of the penguin kind. Their wings are much shorter, more scantily furnished with quills, and the whole pinion placed too forward, to be usefully employed. For this reason the largest of the penguin kind, that have a thick, heavy body to raise, cannot fly at all. Their wings serve them rather as paddlers to help them forward, when they attempt to move swiftly; and in a manner walks along the surface of the water. Even the smaller kinds seldom fly by choice; they flutter their wings with the swiftest efforts without making way; and though they have but a small weight of body to sustain, they seldom venture to quit the water, where they have food and protection.

As the wings of the penguin kind are unfitted for flight, their legs are more awkwardly adapted for walking. This whole tribe have all above the knee hid within the belly; and nothing appears but two short legs or feet, as some would call them, that seem stuck under the rump, and upon which the animal is awkwardly supported. They seem, when sitting, or attempting to walk, like a dog that has been taught to sit up. Their short legs drive the body from side to side; and were they not assisted by their wings, they could scarcely move faster than a tortoise.

The awkward position of their legs, which so unqualifies them for living upon land, adapts them for a residence in water. In that, the legs placed behind the moving body pushes it forward with velocity; and these birds, like Indian canoes, are swiftest in the water, by having their paddles in the rear. Our sailors give these birds the very homely but expressive name of arse-feet.

Nor are they less qualified for diving than swimming. By ever so little inclining their bodies forward, they lose their centre of gravity; and every stroke from their feet only tends to sink them the faster. In this manner they can either dive at once to the bottom, or swim between two waters; where they continue fishing for some minutes, and then ascending, catch an instantaneous breath, to descend once more to renew their operations. Hence it is that these birds, which are so defenceless, and so easily taken by land, are impregnable by water. If they perceive themselves pursued, they instantly sink, and show nothing more than their bills, till the enemy is withdrawn. Their internal conformation assists them in keeping long under water. Their lungs are fitted with numerous vacuities by which they can take in a large inspiration; and this probably serves them for a length of time.

As they never visit land, except when they come to breed, their feathers take a colour from their situation. That part of them which has been continually bathed in the water is white; while their backs and wings are of different colours according to the different species. They are also covered more warmly all over the body with feathers than any other bird whatever; so that the sea seems their element: and but for the necessary duties of propagating their species we should scarcely have the smallest opportunity of seeing them, and should be utterly unacquainted with their history.

Of all this tribe the Magellanic penguin is the largest, and the most remarkable. In size it approaches near that of a tame goose. It never flies, as its wings are very short, and covered with stiff hard feathers, and are always seen expanded, and hanging uselessly down by the bird's sides. The upper part of the head, back, and rump, are covered with stiff, black feathers; while the belly and breast, as is common with all of this kind, are of a snowy whiteness, except a line of black that is seen to cross the crop. The bill, which from the base to about half way is covered with wrinkles, is black, but marked crosswise with a stripe of yellow. They walk erect, with their heads on high, their fin-like wings hanging down like arms; so that to see them at a distance they look like so many children with white aprons. From hence they are said to unite in themselves the qualities of men, fowls, and fishes. Like men, they are upright; like fowls, they are feathered; and like fishes, they have fin-like instruments, that beat the water before, and serve for all the purposes of swimming rather than flying.

They feed upon fish, and seldom come ashore, except in the breeding season. As the seas in that part of the world abound with a variety, they seldom want food; and their extreme fatness seems a proof of the plenty in which they live. They dive with great rapidity, and are voracious to a great degree. One of them, described by Clusius, though but very young, would swallow an entire herring at a mouthful, and often three successively before it was appeased. In consequence of this gluttonous appetite their flesh is rank and fishy; though our sailors say, that *it is pretty good eating*. In some the flesh is so tough, and the feathers so thick, that they stand the blow of a scimitar without injury.

They are a bird of society; and especially when on shore, they are seen drawn up in rank and file, upon the ledge of a rock, standing together with the albatross, as if in consultation. This is previous to their laying, which generally begins in that part of the world in November. Their preparations for laying are attended with no great trouble, as a small depression in the earth, without any other nest, serves for this purpose. The warmth of their feathers, and the heat of their bodies is such, that the progress of incubation is carried on very rapidly.

But there is a difference in the manner of this bird's nestling in other countries, which may be ascribed to the frequent disturbances it has received from many quadrupeds in its recesses. In some places, instead of contenting itself with a superficial depression in the earth, the penguin is found to burrow two or three yards deep: in other places it is seen to forsake the level, and to clamber up the ledge of a rock, where it lays its egg, and hatches in that bleak, exposed situation. These precautions may probably have been taken, in consequence of dear-bought experience. In those countries where the bird fears for her own safety, or that of her young, she may provide against danger, by digging, or even by climbing; for both which she is but ill adapted by nature. But in those places where the penguin has had only few visits from man, her nest is made, with the most confident security, in the middle of some large plain, where they are seen by thousands. In that situation, neither expecting nor fearing an enemy, they continue to sit brooding; and even when man comes among them, have at first no apprehension of danger. Some of this tribe have been called by our seamen *the booby*, from the total insensibility which they show when they are sought to their destruction. But it is not considered that these birds have never been taught to know the dangers of a human enemy: it is against the fox or the vulture that they have learned to defend themselves; but they have no idea of injury from a being so very unlike their natural opposers. The penguins, therefore, when our seamen first came among them, tamely suffered themselves to be knocked on the head, without even attempting an escape. They have stood to be shot at in flocks, without offering to move, in silent wonder, till every one of their number has been destroyed. Their attachment to their nests was still more powerful; for the females tamely suffered the men to approach and take their eggs, without any resistance. But the experience of a few of those unfriendly visits has long since taught them to be more upon their guard in choosing their situations; or to leave those retreats where they were so little able to oppose their invaders.

The penguin lays but one egg; and in frequented shores is found to burrow like a rabbit: sometimes three or four take possession of one hole, and hatch their young together. In the holes of the rocks, where nature has made them a retreat, several of this tribe, as Linnæus assures us, are seen together. There the females lay their single egg in a common nest, and sit upon this, their general possession, by turns; while one is placed as a centinel, to give warning of approaching danger. The egg of the penguin is very large for the size of the bird, being generally bigger than that of a goose. But there are many varieties of the penguin, which differ in size, from that of a Muscovy duck to a swan; the eggs differ in the same proportion.

OF THE AUK, PUFFIN, AND OTHER BIRDS OF THE PENGUIN KIND.

Of a size greatly inferior to the penguin, but with nearly the same form, and of the same appetites and manners, there is a numerous tribe. These frequent our shores, and, like the penguin, have their legs placed behind. They have short wings, which are not totally incapable of flight; with round bills for seizing their prey, which is fish. They live upon the water, in which they are continually seen diving; and seldom venture upon land, except for the purposes of continuing their kind.

The first of this smaller tribe is the great northern diver, which is nearly the size of a goose; it is beautifully variegated all over with many stripes, and differs from the penguin in being more slender, and elegantly formed. The grey speckled diver does not exceed the size of a Muscovy duck; and except in size greatly resembles the former. The auk, which breeds on the islands of St. Kilda, and chiefly differs from the penguin in size and colour, is smaller than a duck; and the whole of its breast and belly, as far as the middle of the throat, is white. The guillemot is about the same size; it differs from the auk in having a longer, more slender, and straighter bill. The scarlet-throated diver may be distinguished by its name; and the puffin, or coulterneb, is one of the most remarkable birds we know.

Words cannot easily describe the form of the bill of the puffin, which differs so greatly from that of any other bird. The beak of this odd-looking animal is somewhat like the coulter of a plough. The bill is flat; but different from that of the duck, its edge is upwards. It is of a triangular figure, and ending in a sharp point; the upper chap bent a little downward, where it is joined to the head: and a certain callous substance encompassing its base, as in parrots. It is of two colours; ash-coloured near the base, and red towards the point. It has three furrows or grooves impressed in it; one in the livid part, two in the red. The eyes are fenced with a protuberant skin, of a livid colour; and they are grey or ash-coloured. These are marks sufficient to distinguish this bird by; but its value to those in whose vicinity it breeds renders it more an object of curiosity.

The puffin, like all the rest of this kind, has its legs thrown so far back, that it can hardly move without tumbling. This makes it rise with difficulty, and subject to many falls before it gets upon the wing: but as it is a small bird, not much bigger than a pigeon, when it once rises, it can continue its flight with great celerity.

Both this and the former build no nest; but lay their eggs either in crevices of rocks, or holes under ground near the shore. They chiefly choose the latter situation; for the puffin, the auk, the guillemot, and the rest, cannot easily rise to the nest when in a lofty situation. Many are the attempts these birds make to fly up to those nests which are so high above the surface. In rendering them inaccessible to mankind, they often render them almost inaccessible to themselves. They are frequently obliged to make three or four efforts, before they can come to the place of incubation. For this reason the auk and the guillemot, when they have laid their single egg, which is large for their size, seldom forsake it till it is excluded. The male, who is better furnished for flight, feeds the female during this interval; and so bare is the place where she sits, that the egg would often roll down from the rock, did not the body of the bird support it.

But the puffin seldom chooses these troublesome heights for its situation. Relying on its courage and the strength of its bill, with which it bites most terribly, it either makes or finds a hole in the ground, where to lay and bring forth its young. All the winter these birds, like the rest, are absent; visiting regions too remote for discovery. At the latter end of March, or the beginning of April, come over a troop of their spies or harbingers, that stay two or three days, as it were to search out for their former situations, and see whether all be well. This done they again depart; and about the beginning of May return with the whole body of their companions. But if the season happens to be stormy and tempestuous, and the sea troubled, the unfortunate voyagers undergo incredible hardships; and they are found by hundreds, cast away upon the shores, lean and perished with famine. It is probable that this voyage is performed more on the water than in the air; and as they cannot fish in stormy weather, their strength is exhausted before they can arrive at their wished-for harbour.

The puffin, when it prepares for breeding, which always happens a few days after its arrival, begins to scrape up a hole in the ground not far from the shore, and when it has some way penetrated the earth, it throws itself upon its back, and with bill and claws burrows inward, till it has dug a hole with several windings and turnings, from eight to ten feet deep. It particularly seeks to dig under a stone, where it expects greater security. In this retreat it lays one egg; which, though the bird be not much bigger than a pigeon, is of the size of a hen's.

When the young one is excluded, the parent's industry and courage is incredible. Few birds or beasts will venture to attack them in their retreats. When the great sea-raven, as Jacobson informs us, comes to take away their young, the puffins boldly oppose him. Their meeting affords a most singular combat. When the raven approaches, the puffin catches him under the throat with its beak, and sticks its claws into its breast, which makes the raven, with loud screaming, attempt to get away; but the little bird holds fast to the invader, nor lets him go till they both come to the sea, where they drop down together, and the raven is drowned; yet the raven is but too often successful; and invading the puffin at the bottom of its hole, devours both the parent and its family.

But were a punishment to be inflicted for immorality in irrational animals, the puffin is justly a sufferer from invasion, as it is often itself one of the most terrible invaders. Near the Isle of Anglesea, in an islet called *Priesholm*, their flocks may be compared, for multitude, to swarms of bees. In another islet, called *the Calf of Man*, a bird of this kind, but of a different species, is seen in great abundance. In both places numbers of rabbits are found to breed; but the puffin, unwilling to be at the trouble of making a hole, when there is one ready made, dispossesses the rabbits, and, it is not unlikely, destroys their young. It is in these unjustly acquired retreats that the young puffins are found in great numbers, and become a valuable acquisition to the natives of the place. The old ones, (I am now speaking of the Manks puffin) early in the morning, at break of day, leave their nests and young, and even the island, nor do they return till night-fall. All this time they are diligently employed in fishing for their young; so that their retreats on land, which in the morning were loud and clamorous, are now still and quiet, with not a wing stirring till the approach of dusk, when their screams once more announce their return. Whatever fish, or other food they have procured in the day, by night begins to suffer a kind of half digestion, and is reduced to an oily matter, which is ejected from the stomach of the old ones into the mouth of the young. By this they are nourished, and become fat to an amazing degree. When arrived to their full growth, they who are entrusted by the lord of the island draw them from their holes; and that they may more readily keep an account of the number they take, cut off one foot as a token. Their flesh is said to be very rank, as they feed upon fish, especially sprats and sea-weed; but when pickled and preserved with high spices they are admired by those who are fond of high eating. Formerly their flesh was allowed by the church on Lenten days. They were at that time also taken by ferrets, as we do rabbits. At present they are either dug out, or drawn out, from their burrows, with a hooked stick. They bite very hard, and keep such fast hold of whatever they seize upon, as not to be easily disengaged. Their noise when taken is very disagreeable, being like the efforts of a dumb person attempting to speak.

The constant depredation which these birds annually suffer does not in the least seem to intimidate them, or drive them away; on the contrary, as the people say, the nest must be robbed, or the old ones will breed there no longer. All birds of this kind lay but one egg; yet if that be taken away they will lay another, and so on to a third; which seems to imply, that robbing their nests does not intimidate them. Those, however, whose nests have been thus destroyed, are often too late in bringing up their young; who, if they be not fledged and prepared for migration when the rest depart, are left at land to shift for themselves. In August the whole tribe takes leave of their summer residence; nor are they observed any more till the return of the ensuing spring. It is probable that they sail away to more southern regions, as our mariners frequently see myriads of water-fowl upon their return, and steering usually to the north. Indeed the coldest countries seem to be their favourite retreats; and the number of water-fowl is greater in colder climates than in warmer regions nearer the line. The quantity of oil which abounds in their bodies serves as a defence against cold, and preserves them against its severity; but the same provision of oil is rather detrimental in warm countries, as it turns rancid, and many of them die of disorders which arise from its putrefaction. But water-fowl in general can be said to be of no climate; the element upon which they live being their proper residence. They spend a few months of summer upon land, to bring up their young; but the rest of their time is probably consumed in their migrations, or near some unknown coast, where fish is found in greatest abundance.

Before I go to the third general division of water-fowls, it may not be improper to observe, that there is one species of round-billed water-fowl, that does not properly lie within any of the former distributions. This is the gooseander; a bird with the body and wing shaped like those of the penguin kind, but with legs not hid in the belly. It may be distinguished from all others by its bill, which is round, hooked at the point, and toothed, both upper and under chap, like a saw. Its colours are various and beautiful: but its manners and appetites resemble those of the diver. It feeds upon fish, for which it dives; and builds its nest upon trees, like the heron and cormorant. It seems to form the shade between the penguin and the goose kind; having a round bill like the one; and unembarrassed legs, like the other. In the shape of the head, neck, and body, it resembles them both.

OF BIRDS OF THE GOOSE KIND, PROPERLY SO CALLED.

The swan, the goose, and the duck, are leaders of a numerous, useful, and beautiful tribe of birds, that we have reclaimed from a state of nature, and taught to live in dependence about us. To describe any of these would be as superfluous as definitions usually are when given of things with which we are already well acquainted. Though it be easy to distinguish these in general from each other, yet the largest of the duck kind approach the goose so nearly, that it may be proper to mark the distinctions.

The marks of the goose are, a bigger body, large wings, a longer neck, a white ring about the rump, a bill thicker at the base, slenderer towards the tip, with shorter legs, placed forward on the body. They both have a waddling walk; but the duck in a greater degree. By these marks these similar tribes may be known asunder; and though the duck should be found to equal the goose in size, which sometimes happens, yet there are still other distinctions.

But they all agree in many particulars; and have a nearer affinity to each other than the neighbouring kinds in any other department. Their having been tamed has produced alterations in each, by which they differ as much from the wild ones of their respective kinds as they do among themselves. There is nearly as much difference between the wild and the tame duck as between some sorts of the duck and the goose; but still the characteristics of the kind are strongly marked and obvious; and this tribe can never be mistaken.

The bill is the first great obvious distinction of the goose kind from all of the feathered tribe. In all the goose kind it is flat and broad, made for the purpose of skimming ponds and lakes of the weeds that stand on the surface. The bills of other birds are made of a horny substance throughout; these have their inoffensive bills sheathed with a skin which covers them all over. The bill of every other bird seems in some measure formed for piercing or tearing; theirs are only fitted for shovelling up their food, which is chiefly of the vegetable kind.

Though these birds do not reject animal food when offered them, yet they contentedly subsist upon vegetables, and seldom seek any other. They are easily provided for; and wherever there is water, there seems to be plenty. All the other web-footed tribes are continually voracious. These lead more harmless lives: the weeds on the surface of the water, or the insects at the bottom, the grass by the bank, or the fruits and corn in cultivated grounds, are sufficient to satisfy them; yet these, like every other animal, will not reject flesh, if properly prepared for them; but they do not eagerly pursue it.

As their food is chiefly vegetables, so their fecundity is in proportion. We have had frequent opportunities to observe, that all the predatory tribes, whether of birds or of quadrupeds, are barren and unfruitful; but these seem formed to fill up the chasms in animated nature, caused by the voraciousness of others. They breed in great abundance, and lead their young to the pool the instant they are excluded.

As their food is simple so their flesh is nourishing and wholesome. The swan was considered as a high delicacy among the ancients; the goose was abstained from as totally indigestible. Modern manners have inverted tastes; the goose is now become the favourite; and the swan is seldom brought to table unless for the purposes of ostentation. But at all times the flesh of the duck was in high esteem; the ancients thought even more highly of it than we do. We are contented to eat it as a delicacy; they also considered it as a medicine; and Plutarch assures us, that Cato kept his whole family in health by feeding them with duck whenever they threatened to be out of order.

These qualities of great fecundity, easy sustenance, and wholesome nourishment have been found so considerable as to induce man to take these birds from a state of nature and render them domestic. How long they have been thus dependents upon his pleasures is not known; for from the earliest accounts they were considered as familiars about him. The time must have been very remote; for there have been many changes wrought in their colours, their figures, and even their internal parts, by human cultivation. The different kinds of these birds in a wild state are simple in their colourings: when one has seen a wild goose or a wild duck, a description of its plumage will to a feather correspond with that of any other. But in the tame kinds no two of any species are exactly alike. Different in their size, their colours, and frequently in their general form, they seem the mere creatures of art; and having been so long dependent upon man for support, they seem to assume forms entirely suited to his pleasures or necessities.

OF THE SWAN, TAME AND WILD.

The swan makes an indifferent figure upon land, but a beautiful one in the water. When it ascends from its favourite element, its motions are awkward, and its neck is stretched forward with an air of stupidity; but when it is sailing along the water, commanding a thousand graceful attitudes, moving at pleasure without the smallest effort; when it 'proudly rows its state,' as Milton has it, 'with arched neck, between its white wings mantling,' there is not a more beautiful figure in all nature. In the exhibition of its form there are no broken or harsh lines; no constrained or catching motions; but the roundest contours, and the easiest transitions; the eye wanders over every part with insatiable pleasure, and every part takes a new grace with new motion.

This fine bird has long been rendered domestic; and it is now a doubt whether there be any of the tame kind in a state of nature. The wild swan, though so strongly resembling this in colour and form, is yet a different bird; for it is very differently formed within. The wild swan is less than the tame by almost a fourth; for as the one weighs twenty pounds, the other only weighs sixteen pounds and three quarters. The colour of the tame swan is all over white; that of the wild bird is, along the back and the tips of the wings, of an ash-colour.

As it is not easy to account for this difference of conformation, so it is still more difficult to reconcile the accounts of the ancients with the experience of the moderns, concerning the vocal powers of this bird. The tame swan is one of the most silent of all birds; and the wild one has a loud and disagreeable note. It is probable, the convolutions of the windpipe may contribute to increase the clangour of it; for such is the harshness of its voice, that the bird from thence has been called the *hooper*. In neither is there the smallest degree of melody; nor have they for above this century been said to give specimens of the smallest musical abilities; yet notwithstanding this, it was the general opinion of antiquity, that the swan was a melodious bird; and that even to its death its voice went on improving. The nonsensical stories that have been published concerning this bird we shall omit.

This beautiful bird is as delicate in its appetites as it is elegant in its form. Its chief food is corn, bread, herbs growing in the water, and roots and seeds, which are found near the margin. It prepares a nest in some retired part of the bank, and chiefly where there is an islet in the stream. This is composed of water plants, long grass, and sticks; and the male and female assist in forming it with great assiduity. The swan lays seven or eight eggs, white, much larger than those of a goose, with a hard, and sometimes a tuberous shell. It sits near two months before its young are excluded; which are ash-coloured when they first leave the shell, and for some months after. It is not a little dangerous to approach the old ones, when their little family are feeding round them. Their fears, as well as their pride, seem to take the alarm; and they have sometimes been known to give a blow with their pinion that has broke a man's leg or arm.

It is not till they are a twelvemonth old that the young swans change their colour with their plumage. All the stages of this bird's approach to maturity are slow, and seem to mark its longevity. It is two months hatching; a year in growing to its proper size: and if, according to Pliny's observation, that those animals that are longest in the womb are the longest lived, the swan is the longest in the shell of any bird we know, and is said to be remarkable for its longevity. Some say that it lives three hundred years; and Willoughby, who is in general diffident enough, seems to believe the report. A goose, as he justly observes, has been known to live a hundred; and the swan from its superior size, and from its harder, firmer flesh, may naturally be supposed to live still longer.

Swans were formerly held in such great esteem in England, that by an act of Edward the Fourth none except the son of the king was permitted to keep a swan, unless possessed of five marks a year. By a subsequent act, the punishment for taking their eggs was imprisonment for a year and a day, and a fine at the king's will. At present they are but little valued for the delicacy of their flesh; but many are still preserved for their beauty. We see multitudes on the Thames and Trent; but no where greater numbers than on the salt water inlet of the sea near Abbotsbury in Dorsetshire.

OF THE GOOSE AND ITS VARIETIES.

The goose, in its domestic state, exhibits a variety of colours. The wild goose always retains the same marks: the whole upper part is ash-coloured; the breast and belly are of a dirty white; the bill is narrow at the base, and at the tip it is black; the legs are of a saffron colour, and the claws black. These marks are seldom found in the tame, whose bill is entirely red, and whose legs are entirely brown. The wild goose is rather less than the tame; but both invariably retain a white ring round their tail, which shows that they are both descended from the same original.

The wild goose is supposed to breed in the northern parts of Europe; and, in the beginning of winter, to descend into more temperate regions. They are often seen flying at very great heights, in flocks from fifty to a hundred, and seldom resting by day. Their cry is heard when they are at an amazing distance above us; and this seems bandied from one to the other, as among hounds in pursuit. Whether this be the note of mutual encouragement, or the consequence of respiration, is doubtful; but they seldom exert it when they alight in these journeys.

Upon their coming to the ground by day, they range themselves in a line, and seem rather to have descended for rest than refreshment. When they have sat in this manner for an hour or two, I have heard one of them, with a loud long note, sound a kind of charge, to which the rest attended, and pursued their journey with renewed alacrity. Their flight is regularly arranged: they either go in a line a-breast, or in two lines, joining in an angle in the middle.

The barnacle differs in some respects from both these; being less than either, with a black bill, much shorter than either of the preceding. It is scarcely necessary to combat the idle error of this bird's being bred from a shell sticking to ship's bottoms; it is well known to be hatched from an egg, in the ordinary manner, and to differ in few particulars from the rest of its kind.

The brent goose is still less than the former, and not bigger than a Muscovy duck, except that the body is longer. The head, neck, and upper part of the breast are black; about the middle of the neck, on each side, are two small spots or lines of white, which together appear like a ring.

These, and many other varieties, are found in this kind; which agree in one common character of feeding upon vegetables, and being remarkable for their fecundity. But the tame goose is most fruitful. Having less to fear from its enemies, leading a securer and more plentiful life, its powers increase in proportion to its ease; and though the wild goose seldom lays above eight eggs, the tame one often lays above twenty. The female hatches her eggs with great assiduity; while the gander visits her twice or thrice a day, and sometimes drives her off to take her place, where he sits with state and composure.

Of all animals his pride is greatest when the young are excluded; he seems then to consider himself as a champion, not only obliged to defend his young, but also to keep off the suspicion of danger; he pursues dogs and men that never attempt to molest him: and, though the most harmless thing alive, is then the most petulent and provoking. When, in this manner, he has pursued the calf or the mastiff, to whose contempt alone he is indebted for safety, he returns to his female and her brood in triumph, clapping his wings, screaming, and showing all the marks of conscious superiority.

A young goose is generally reckoned good eating; yet the feathers of this bird still farther increase its value. I feel my obligations to this animal every word I write; for, however deficient a man's head may be, his pen is nimble enough upon every occasion; it is happy indeed for us, that it requires no great effort to put it in motion. But the feathers of this bird are still as valuable in another capacity, as they make the softest and warmest beds to sleep on.

Of goose feathers most of our beds in Europe are composed; in the countries bordering on the Levant, and in all Asia, the use of them is utterly unknown. They there use mattrasses, stuffed with wool, or camel's hair, or cotton; and the warmth of their climates may perhaps make them dispense with cushions of a softer kind.

As feathers are a valuable commodity, great numbers of geese are kept tame in the fens in Lincolnshire, which are plucked once or twice a-year. These make a considerable article of commerce. The feathers of Somersetshire are most in esteem; those of Ireland are reckoned the worst. Hudson's Bay also furnishes fine feathers, supposed to be of the goose kind. The down of the swan is brought from Dantzic. The same place also sends us great quantities of the feathers of the cock and hen; but Greenland, Iceland, and Norway, furnish the best feathers of all: and in this number we may reckon the Eider-down, of which we shall take notice in this place. The best method of curing feathers, is to lay them in a room in an open exposure to the sun, and when dried, to put them into bags, and beat them well with poles to get the dust off. But after all, nothing will prevent for a time, the heavy smell which arises from the putrefaction of the oil contained in every feather; no exposure will draw this off, how long soever it be continued; they must be laid upon, which is the only remedy: and for this reason, old feathers are much more valuable than new.

OF THE DUCK AND ITS VARIETIES.

The tame duck is the most easily reared of all our domestic animals. The very instincts of the young ones direct them to their favourite element; and though they are conducted by a hen, yet they despise the admonitions of their leader.

This serves as an incontestible proof that all birds have their manners rather from nature than education. A falcon pursues the partridge, not because it is taught by the old one, but because its appetites make their importunate call for animal food; the cuckoo follows a different trade from that which its nurse endeavoured to teach it; and, if we may credit Pliny, in time destroys its instructor; animals of the duck kind follow their appetites, not their tutor, and come to their various perfections without any guide. All the arts possessed by man, are the result of experience; all the arts of inferior animals are self-taught, and scarcely one acquired by imitation.

It is usual with good women to lay duck eggs under a hen, because she hatches them better than the original parent would have done. The duck seems to be a heedless, inattentive mother; she frequently leaves her eggs till they spoil, and seems to forget that she is intrusted with the charge: she is equally regardless of them when excluded; she leads them to the pond, and thinks she has provided for her offspring when she has shown them the water. Whatever advantages may be procured by coming near the house, or attending the yard, she declines them all; and often lets the vermin, who haunt the waters, destroy them, rather than bring them to take shelter nearer home. The hen is a nurse of an opposite character; she broods with assiduity, and brings forth a young one from every egg committed to her charge; she does not lead her younglings to the water, but she guards them when there by standing at the brink. Should the rat, or the weasel, attempt to seize them, the hen can give them protection; she leads them to the house when tired with paddling, and rears up the supposititious brood, without ever suspecting that they belong to another.

The wild duck differs, in many respects, from the tame; and in them there is still a greater variety than among the domestic kinds. Of the tame duck there are not less than ten sorts; and of the wild, Brisson reckons above twenty. The most obvious distinction between wild and tame ducks is in the colour of their feet: those of the tame duck being yellow, those of the wild duck black. The difference between wild ducks among each other, arises as well from their size as the nature of the place they feed in. Sea-ducks, which feed in the salt waters, and dive much, have a broad bill, bending upwards, a large hind-toe, and a long blunt tail. Pond-ducks, which feed in plashes, have a straight and narrow bill, a small hind-toe, and a sharp pointed train. The former are called, by our decoy-men, *foreign ducks;* the latter are supposed to be natives of England. It would be tedious to enter into the minute varieties of such a number of birds; all agreeing in the same general figure, the same habits and mode of living, and differing in little more than their size and the colours of their plumage. In this tribe, we may rank, as natives of our own European dominions, the eider duck, which is double the size of a common duck, with a black bill; the velvet duck, not so large, and with a yellow bill; the scoter, with a knob at the base of a yellow bill; the tufted duck, adorned with a thick crest; the scaup duck, less than the common duck, with the bill of a greyish-blue colour; the golden eye, with a large white spot at the corners of the mouth, resembling an eye; the sheldrake, with the bill of a bright red, and swelling into a knob; the mallard, which is the stock from whence our tame breed has probably been produced; the pintail, with the two middle feathers of the tail three inches longer than the rest; the pochard, with the head and neck of a bright bay; the widgeon, with a lead-coloured bill, and the plumage of the back marked with narrow black and white undulated lines, but best known by its whistling sound; lastly, the teal, which is the smallest of this kind, with the bill black, the head and upper part of the neck of a bright bay. These are the most common birds of the duck kind among ourselves; but who can describe the amazing variety of this tribe, if he extends his view to the different quarters of the world? The most noted of the foreign tribe are, the Muscovy duck, or, more properly speaking, the musk dusk, so called from a supposed musky smell, with naked skin round the eyes, and which is a native of Africa; the Brasilian duck, that is of the size of a goose, all over black except the tips of the wings. The American wood duck, with a variety of beautiful colours, and a plume of feathers that falls from the back of the head like a friar's cowl. These, and twenty others, might be added, were increasing the number of names the way to enlarge the sphere of our comprehension.

All these live in the manner of our domestic ducks, keeping together in flocks in the winter, and flying in pairs in summer, bringing up their young by the water-side, and leading them to their food as soon as hatched. Their nests are usually built among heath or rushes, not far from the water, and they lay twelve, fourteen, or more eggs before they sit; yet this is not always their method; the dangers they continually encounter from their ground situation, sometimes obliges them to change their manner of building; and their awkward nests are often seen exalted on the tops of trees. This must be a very great labour to perform, as the duck's bill is but ill-formed for building a nest, and giving the materials of which it is formed a sufficient stability to stand the weather. The nest, whether high or low, is generally composed of singular materials. The longest grass, mixed with heath, and lined with the bird's own feathers, usually go to the composition: but in proportion as the climate is colder, the nest is more artificially made, and warmly lined.

In the Arctic regions nothing can exceed the great care all of this kind take to protect their eggs from the intenseness of the weather. While the gull and the penguin kind seem to disregard the severest cold, the duck, in those regions, forms itself a hole to lay in, shelters the approach, lines it with a layer of long grass and clay; within that another of moss; and, lastly, a warm coat of feathers or down. The eider duck is particularly remarkable for the warmth of its nest. This bird, which, as was said, is about twice as large as the common duck, and resides in the colder climates, lays from six to eight eggs, making her nest among the rocks or the plants along the sea-shore. The external materials of the nest are such as are in common with the rest of the kind; but the inside lining, on which the eggs are immediately deposited, is at once the softest, warmest, and the lightest substance with which we are acquainted. This is no other than the inside down which covers the breast of the bird in the breeding season. This the female plucks off with her bill, and furnishes the inside of her nest with a tapestry more valuable than the most skilful artists can produce. The natives watch the place where she begins to build, and suffering her to lay, take away both the eggs and the nest. But the duck, not discouraged by the first disappointment, builds and lays in the same place a second time; and this they in the same manner take away: the third time she builds, but the drake must supply the down from his breast to line the nest with; and if this be robbed, they both forsake the place, and breed there no more. This down the natives take care to separate from the dirt and moss with which it is mixed; and though no people stand in more need of a warm covering than themselves, yet their necessities compel them to sell it to the more luxurious inhabitants of the south for brandy and tobacco.

As they possess the faculties of flying and swimming, so they are in general birds of passage, and it is most probable perform their journeys across the ocean as well on the water as in the air. Those that migrate to this country, on the approach of winter, are seldom found so well tasted or so fat as the fowls that continue with us the year round; their flesh is often lean, and still oftener fishy; which flavour it has probably contracted in the journey, as their food in the lakes of Lapland, from whence they descend, is generally of the insect kind.

When they arrive among us, they fly in flocks to make a survey of those lakes where they intend to take up their residence for the winter. In the choice of these they have two objects in view; to be near their food, and yet remote from interruption. Their chief aim is to choose some lake in the neighbourhood of a marsh, where there is at the same time a cover of woods, and where insects are found in abundance. Lakes, with a marsh on one side, and a wood on the other, are seldom without vast quantities of wild fowl; and where a couple are seen, that is a sufficient inducement to bring hundreds of others. The ducks flying in the air are often lured from their heights by the voice of the mallard from below. Nature seems to have furnished this bird with faculties for calling. The windpipe, where it begins to enter the lungs, opens into a kind of bony cavity, where the sound is reflected as in a musical instrument, that is heard a great way off. To this call all the stragglers resort; and in a week or a fortnight's time, a lake that before was naked is black with water-fowl that have left their Lapland retreats to keep company with our ducks who never stirred from home.

They generally choose that part of the lake where they are inaccessible to the approach of the fowler, in which they all appear huddled together, very busy and noisy. What it is can employ them all the day is not easy to guess. There is no food for them at the place where they sit and cabal thus, as they choose the middle of the lake; and as for courtship, the season for that is not yet come; so that it is wonderful what can so busily keep them occupied. Not one of them seems a moment at rest. Now pursuing one another, now screaming, then all up at once, then down again; the whole seems one strange scene of bustle, with nothing to do.

They frequently go off in a private manner by night to feed in the adjacent meadows and ditches, which they dare not venture to approach by day. In these nocturnal adventures they are often taken; for though a timorous bird, yet they are easily deceived, and every springe seems to succeed in taking them. But the greatest quantities are taken in decoys; which though well-known near London, are yet untried in the remoter parts of the country. The manner of making and managing a decoy is as follows:

A place is to be chosen for this purpose remote from the common highway and all noise of people. A decoy is best where there is a large pond surrounded by a wood, and beyond that a marshy and uncultivated country. When the place is chosen, the pool, if possible, is to be planted round with willows, unless a wood answers the purpose of shading it on every side. On the south and north side of this pool are two, three, or four ditches or channels, made broad towards the pool, and growing narrower till they end in a point. These channels are to be covered over with nets, supported by hooped sticks bending from one side to the other; so that they form a vault or arch growing narrower and narrower to the point, where it is terminated by a tunnel net, like that in which fish are caught in weirs. Along the banks of these channels so netted over, which are called pipes, many hedges are made of reeds slanting to the edge of the channel, the acute angles to the side next the pool. The whole apparatus also is to be hidden from the pool by a hedge of reeds along the margin, behind which a fowler manages his operations. The place being fitted in this manner, the fowler is to provide himself with the number of wild ducks made tame, which are called decoys. These are always to be fed at the mouth or entrance of the pipe, and to be accustomed to come at a whistle.

When the evening sets in, *the decoy rises*, as they term it, and the wild fowl feed during the night. If the evening be still, the noise of their wings, during their flight, is heard at a great distance, and produces no unpleasing sensation. The fowler, when he finds a fit opportunity, and sees his decoy covered with fowl, walks about the pool, and observes into what pipe the birds gathered in the pool may be enticed or driven. Then casting hemp-seed, or some such seed as will float on the surface of the water, at the entrance, and up along the pipe, he whistles to his decoy-ducks, who instantly obey the summons, and come to the entrance of the pipe, in hopes of being fed as usual. Thither also they are followed by a whole flock of wild ones, who little suspect the danger preparing against them. Their sense of smelling, however, is very exquisite; and they would soon discover their enemy, but that the fowler always keeps a piece of turf burning at his nose, against which he breathes, and this prevents the effluvia of his person from reaching their exquisite senses. The wild ducks, therefore pursuing the decoy-ducks, are led into the broad mouth of the channel or pipe, nor have the least suspicion of the man, who keeps hidden behind one of the hedges. But when they have got up the pipe, finding it grow narrower, they begin to suspect danger, and would return back; but they are now prevented by the man, who shows himself at the broad end below. Thither, therefore, they dare not return; and rise they may not, as they are kept by the net above from ascending. The only way left them, therefore, is the narrow funneled net at the bottom; into this they fly, and there they are taken.

It often happens that the wild-fowl are in such a state of sleepiness or dozing, that they will not follow the decoy-ducks. Use is then generally made of a dog, who is taught his lesson. He passes backward and forward between the reed-hedges, in which there are little holes, both for the decoy-man to see, and for the little dog to pass through. This attracts the eye of the wild-fowl; who, prompted by curiosity, advance towards this animal, while he keeps playing among the reeds, nearer and nearer the funnel, till they follow him too far to recede. Sometimes the dog will not attract their attention till a red handkerchief, or something singular, be put about him. The decoy-ducks never enter the funnel-net with the rest, being taught to dive under water as soon as the rest are driven in.

The general season for catching fowl in decoys is from the latter end of October till February. The taking them earlier is prohibited by an Act of George the Second, which imposes a penalty of five shillings for every bird destroyed at any other season.

The Lincolnshire decoys are commonly let at a certain annual rent, from five to twenty pounds a year; and some even to thirty. These contribute to supply the markets of London with wild fowl. The number of ducks, widgeon, and teal, that are sent thither is amazing. Thirty thousand have been sent up in one season from ten decoys in the neighbourhood of Wainfleet. This quantity makes them so cheap on the spot, that it is asserted, the several decoy-men would be glad to contract for years to deliver their ducks at their next town for tenpence the couple.

To this manner of taking the wild-fowl in England, I will subjoin another still more extraordinary, frequently practised in China. Whenever the fowler sees a number of ducks settled in any particular plash of water, he sends off two or three gourds to float among them. These gourds resemble our pompions; but, being made hollow, they swim on the surface of the water; and on one pool there may sometimes be seen twenty or thirty of them floating together. The fowl at first are a little shy of coming near them; but by degrees they come nearer; and as all birds at last grow familiar with a scare-crow, the ducks gather about these, and amuse themselves by whetting their bills against them. When the birds are as familiar with the gourds as the fowler could wish, he then prepares to deceive them. He hollows out one of those gourds large enough to put his head in; and, making holes to breathe and see through, he claps it on his head. Thus accoutred, he wades slowly into the water, keeping his body under, and nothing but his head in the gourd above the surface; and in that manner moves imperceptibly towards the fowls, who suspect no danger. At last he gets in among them; while they, having been long used to see gourds, take not the least fright while the enemy is in the very midst of them; and an insidious enemy he is; for ever as he approaches a fowl, he seizes it by the legs, and draws it in a jerk under water. There he fastens it under his girdle, and goes to the next, till he has thus loaded himself with as many as he can carry away. When he has got his quantity, without attempting to disturb the rest of the fowls on the pool, he moves off again; and in this manner pays the flock three or four visits in a day. Of all the various artifices for catching fowl, this seems likely to be attended with the greatest success, as it is the most practised in China.

OF THE KING-FISHER.

I SHALL conclude this history of birds with one that seems to unite in itself somewhat of every class preceding. It seems at once possessed of appetites for prey, like the rapacious kinds, and with an attachment to water, like the birds of that element. It exhibits in its form the beautiful plumage of the peacock, the shadings of the humming-bird, the bill of the crane, and the short legs of the swallow. This is the king-fisher, of which many falsehoods have been propagated; and yet of which many things remain to be said that are actually true.

The king-fisher is not much larger than a swallow; its shape is clumsy; the legs disproportionably small, and the bill disproportionably long; it is two inches from the base to the tip; the upper chap black, and the lower yellow; but the colours of this bird atone for its inelegant form; the crown of the head and the coverts of the wings are of a deep blackish grey, spotted with bright azure; the back and tail are of the most resplendent azure; the whole under side of the body is orange-coloured; a broad mark of the same passes from the bill beyond the eyes; beyond that is a large white spot; the tail is short, and consists of twelve feathers of a rich deep blue; the feet are of a reddish yellow, and the three joints of the outmost toe adhere to the middle one, while the inner toe adheres only by one.

From the diminutive size, the slender short legs, and the beautiful colours of this bird, no person would be led to suppose it one of the most rapacious little animals that skims the deep. Yet it is always on the wing, and feeds on fish, which it takes in surprising quantities, when we consider its size and figure. It frequents the banks of rivers, and takes its prey after the manner of the osprey, balancing itself at a distance above the water for a considerable space, then darting into the deep, and seizing the fish with certainty. While it remains suspended in the air, in a bright day, the plumage exhibits a beautiful variety of dazzling and brilliant colours. It might have been this beauty that has given rise to fable; for wherever there is any thing uncommon, fancy increases the wonder.

Of this bird it has been said that she built her nest on the water, and thus in a few days hatched and produced her young. But to be interrupted in this task, she was said to be possessed of a charm to allay the fury of the waves; and during this period the mariner might sail with security. The ancient poets are full of these fables; and even their historians are not exempt from them.

The king-fisher with which we are acquainted at present, makes its nest on the banks of rivers, in such situations as not to be affected by the rising of the stream. When it has found a place for its purpose, it hollows out with its bill a hole about a yard deep; or if it finds the deserted hole of a rat, or one caused by the root of a tree decaying, it takes quiet possession. This hole it enlarges at the bottom to a good size; and lining it with willow down, lays its eggs there without any farther preparation.

Its nest, or rather hole, is different from that described by the ancients, by whom it is said to be made in the shape of a long necked gourd of the bones of the sea-needle. The bones indeed are found there in great quantities as well as the scales of fishes; but these are the remains of the bird's food, and by no means brought there for the purposes of warmth or convenience. The king-fisher, as Bellonius says, feeds upon fish, but is incapable of digesting the bones and scales, which he throws up again, as eagles and owls are seen to do a part of their prey. These fill the bird's nest of course; and, although they seem as if designedly placed there, are only a kind of nuisance.

In these holes, which, from the remains of fish brought there, are very fœtid, the king-fisher is often found with from five eggs to nine. These the female continues to hatch, even though disturbed; and though the nest be robbed, she will again return and lay there. 'I have had one of those females brought me,' says Reaumur, 'which was taken from her nest about three leagues from my house. After admiring the beauty of her colours, I let her fly again, when the fond creature was instantly seen to return back to the nest where she had just before been made a captive. There, joining the male, she again began to lay, though it was for the third time, and though the season was very far advanced. At each time she had seven eggs. The older the nest is, the greater quantity of fish-bones and scales does it contain: these are disposed without any order; and sometimes take up a good deal of room.'

The female begins to lay early in the season; and excludes her first brood about the beginning of April. The male, whose fidelity exceeds even that of the turtle, brings her large provisions of fish while she is thus employed; and she, contrary to most other birds, is found plump and fat at that season. The male, that used to twitter before this, now enters the nest as quietly and as privately as possible. The young ones are hatched at the expiration of twenty days; but are seen to differ as well in their size as in their beauty.

Having thus given a short history of birds, I own I cannot take leave of this most beautiful part of the creation without reluctance. These splendid inhabitants of air possess all those qualities that can soothe the heart, and cheer the fancy. The brightest colours, the roundest forms, the most active manners, and the sweetest music. In sending the imagination in pursuit of these, in following them to the chirruping grove, the screaming precipice, or the glassy deep, the mind naturally lost the sense of its own situation, and, attentive to their little sports, almost forgot the TASK of describing them. Innocently to amuse the imagination in this dream of life is wisdom; and nothing is useless that, by furnishing mental employment, keeps us for a while in oblivion of those stronger appetites that lead to evil. But every rank and state of mankind may find something to imitate in those delightful songsters, and we may not only employ the time, but mend our lives by the contemplation. From their courage in defence of their young, and their assiduity in incubation, the coward may learn to be brave, and the rash to be patient. The inviolable attachment of some to their companions may give lessons of fidelity; and the connubial tenderness of others, be a monitor to the incontinent. Even those that are tyrants by nature never spread capricious destruction; and, unlike man, never inflict a pain but when urged by necessity.

OF FISHES IN GENERAL.

INTRODUCTION.

THE ocean is the great receptacle of fishes. It has been thought, by some, that all fish are naturally of that salt element; and that they have entered into fresh water by some accidental migration. A few still swim up rivers to deposit their spawn; but of the great body of fishes, of which the size is enormous and the shoals are endless, those all keep to the sea, and would soon expire in fresh water. In that extensive and undiscovered abode, millions reside, whose manners are a secret to us, and whose very form is unknown. The curiosity of mankind, indeed, has drawn some from their depths, and his wants many more: with the figure of these at least he is acquainted; but for their pursuits, migrations, societies, antipathies, pleasures, times of gestation, and manner of bringing forth, these all are hidden in the turbulent element that protects them.

The number of fish to which we have given names, and of the figure, at least, of which we know something, according to Linnæus, are above four hundred. Thus to appearance, indeed, the history of fish is tolerably copious; but when we come to examine, it will be found that of the greatest part of these we know very little. Those qualities, singularities, or advantages, that render animals worth naming, still remain to be discovered. The history of fishes, therefore, has little in it entertaining; for our philosophers hitherto, instead of studying their nature, have been employed in increasing their catalogues; and the reader, instead of observations or facts, is presented with a long list of names that disgust him with their barren superfluity. It must displease him to see the language of a science increasing, while the science itself has nothing to repay the increasing tax laid upon his memory.

Most fish offer us the same external form, sharp at either end, and swelling in the middle; by which they are enabled to traverse the fluid which they inhabit with celerity and ease. That peculiar shape which nature has granted to most fishes, we endeavour to imitate in such vessels as are designed to sail with the greatest swiftness; but the progress of a machine moved forward in the water by human contrivance, is nothing to the rapidity of an animal destined by nature to reside there. Any of the large fish overtake a ship in full sail with great ease, play round it without effort, and outstrip it at pleasure. Every part of the body seems exerted in this dispatch; the fins, the tail, and the motion of the whole back-bone, assist progression; and it is to that flexibility of body at which art cannot arrive, that fishes owe their velocity.

The chief instruments in a fish's motion, are the fins; which in some fish are more numerous than in others. A fish completely fitted for sailing, is furnished with no less than two pair; also three single fins, two above and one below. Thus equipped, it migrates with the utmost rapidity, and takes voyages of a thousand leagues in a season. But it does not always happen that such fish as have the greatest number of fins have the swiftest motion: the shark is thought to be one of the swiftest swimmers, yet it wants the ventral or belly fins; the haddock does not move so swift, yet it is completely fitted for motion.

But the fins serve not only to assist the animal in progression, but in rising or sinking, in turning, or even leaping out of the water. To answer these purposes, the pectoral fins serve, like oars, to push the animal forward; they are placed at a little distance behind the opening of the gills; they are generally large and strong, and answer the same purposes to the fish in the water as wings do to a bird in the air. With the help of these, and by their continued motion, the flying-fish is sometimes seen to rise out of the water, and to fly above an hundred yards; till, fatigued with its exertions, it is obliged to sink down again. These also serve to balance the fish's head, when it is too large for the body, and keep it from tumbling to the bottom when the pectoral fins are cut off. Next these are seen the ventral fins, placed towards the lower part of the body, under the belly; these are always seen to lie flat on the water, in whatever situation the fish may be; and they serve rather to depress the fish in its element than to assist progressive motion. The dorsal fin is situated along the ridge of the back; and serves to keep it in equilibrio, as also to assist its motion. In many fishes this is wanting; but in all flat fishes it is very large, as the pectoral fins are proportionably small. The anal fin occupies that part of the fish which lies between the anus and the tail; and this serves to keep the fish in its upright or vertical situation. Lastly, the tail, which in some fishes is flat, and upright in others, seems the grand instrument of motion; the fins are all subservient to it, and give direction to its great impetus, by which the fish seems to dart forward with so much velocity. To explain all this by experiment; a carp is taken and put into a large vessel. The fish, in a state of repose, spreads all its fins, and seems to rest upon its pectoral and ventral fins near the bottom: if the fish folds up (for it has the power of folding) either of its pectoral fins, it inclines to the same side; folding the right pectoral fin, the fish inclines to the right side; folding the left fin, it inclines to that side in turn. When the fish desires to have a retrograde motion, striking with the pectoral fins in a contrary direction effectually produces it. If the fish desires to turn, a blow from the tail sends it about; but if the tail strikes both ways, then the motion is progressive. In pursuance of these observations, if the dorsal and ventral fins be cut off, the fish reels to the right and left, and endeavours to supply its loss by keeping the rest of its fins constantly employed. If the right pectoral fin be cut off, the fish leans to that side; if the ventral fin on the same side be cut away, then it loses its equilibrium entirely. When the tail is cut off, the fish loses all motion, and gives itself up to where the water impels it.

Hence it appears, that each of these instruments has a peculiar use assigned it; but at the same time that they all conspire to assist each other's motions. Some fish are possessed of all, whose motions are yet not the swiftest; others have but a part, and yet dart in the water with rapidity. The number, the size, and the situation of the fins, seem rather calculated to correspond with the animal's figure, than solely to answer the purposes of promoting its speed. Where the head is large and heavy, the pectoral fins are large, and placed forward, to keep it from oversetting. Where the head is small, or produced out into a long beak, and therefore not too heavy for the tail, the pectoral fins are small, and the ventral fins wanting.

As most animals that live upon land are funished with a covering to keep off the injuries of the weather, so all that live in the water are covered with a slimy, glutinous matter, that, like a sheath, defends their bodies from the contact of the surrounding fluid. This substance may be considered as a secretion from the pores of the animal's body; and serving not only to defend, but to assist the fish's progress through the water. Beneath this, in many kinds, is found a strong covering of scales, that, like a coat of mail, defend it more powerfully; and under that, before we come to the muscular parts of the body, an oily substance, which supplies the requisite warmth and vigour.

The fish, thus protected and fitted for motion in its natural element, seems as well furnished with the means of happiness as quadrupeds or birds; but if we come to examine its faculties more nearly, we shall find it very much their inferior. The sense of touching, which beasts and birds have in a small degree, the fish, covered up in its own coat of mail, can have but little acquaintance with.

The sense of smelling, which in beasts is so exquisite, and among birds is not unknown, seems given to fishes in a very moderate proportion. It is true, that all fishes have one or more nostrils; and even those that have not the holes perceptible without, yet have the proper formation of the bones for smelling within. But as air is the only medium we know for the distribution of odours, it cannot be supposed that these animals, residing in water, can be possessed of any power of being affected by them. If they have any perception of smells, it must be in the same manner as we distinguish by our taste; and it is probable, the olfactory membrane in fish serves them instead of a distinguishing palate: by this they judge of substances, that, from tincturing the water with their vapours, are thus sent to the nostrils of the fish, and no doubt produce some kind of sensation. Probably this is the use of that organ in those animals, which otherwise would be the instruments of a sense provided for them, without any power in them of enjoyment.

As to tasting they seem to make very little distinction; the palate of most fish is hard and bony, and consequently incapable of the powers of relishing different substances. This sense among quadrupeds, who possess it in some degree, arises from the soft pliancy of the organ, and the delicacy of the skin which covers the instruments of tasting; it may be considered in them as a more perfect and delicate kind of feeling: in the bony palate of fish all powers of distinguishing are utterly taken away; and we have often seen these voracious animals swallow the fisherman's plummet instead of the bait.

Hearing in fishes is found still more imperfect, if it be found at all. Certain it is, that anatomists have not been able to discover, except in the whale kind, the smallest traces of an organ, either within or without the head of fishes. It is true, that in the centre of the brain of some fishes are found now and then some little bones, the number and situation of which are entirely accidental. These bones, Mr. Klein has supposed to constitute the organ of hearing; but if we consider their entire dissimilitude to the bones that serve for hearing in other animals, we shall be of another opinion. The greatest number of fishes are deprived of these bones entirely: some fish have them in small numbers, and others in abundance; yet neither testify any excellence or defect in hearing. Indeed, of what advantage would this sense be to animals that are incapable of making themselves heard? they have no voice to communicate with each other, and consequently have no need of an organ for hearing. Mr. Gouan, who kept some gold fishes in a vase, informs us, that whatever noise he made, he could neither disturb nor terrify them; he halloed as loud as he could, putting a piece of paper between his mouth and the water, to prevent the vibrations from affecting the surface, and the fishes still seemed insensible: but when the paper was removed, and the sound had its full play upon the water, the fishes seemed instantly to feel the change, and shrunk to the bottom. From this we may learn, that fishes are as deaf as they are mute: and that when they seem to hear the call of a whistle or a bell at the edge of a pond, it is rather the vibrations of the sound that affect the water, by which they are excited, than any sounds that they hear.

Seeing seems to be the sense fishes are possessed of in the highest degree; and even this seems obscure, if we compare it to that of other animals. The eye, in almost all fish, is covered with the same transparent skin that covers the rest of the head; and which, probably, serves to defend it in the water, as they are without eye-lids. The globe is more depressed anteriorly, and is furnished behind with a muscle, which serves to lengthen or flatten it according to the necessities of the animal. The crystaline humour, which in quadrupeds is flat, and of the shape of a button-mould, in fishes is as round as a pea; or sometimes oblong, like an egg. From all this it appears, that fish are near-sighted; and that, even in the water, they see objects at a small distance.—This distance might easily be ascertained, by comparing the refraction of bodies in the water, with that formed by a lens that is spherical. Those unskilled in mathematical calculations, will have a general idea of this, from the glasses used by near-sighted people. Those whose crystaline humour is too convex, or, in other words, too round, are always very near-sighted; and obliged to use concave glasses to correct the imperfections of Nature. The crystaline humour of fish is so round, that it is not in the power of any glasses, much less of water, to correct their vision. This crystaline humour in fishes all must have seen; being that little hard pea-like substance which is found in their eyes after boiling. In the natural state it is transparent, and not much harder than a jelly.

From all this, it appears how far fish fall behind terrestrial animals in their sensations, and consequently their enjoyments. Even their brain, which is by some supposed to be of a size with every animal's understanding, shows that fish are inferior to birds in this particular. It is divided into three parts, surrounded with a whitish froth, and gives off nerves as well to the sense of sight as of smelling. In some fish it is grey, in others white; in some it is flatted, in others round; but in all extremely small, compared to the bulk of the animal.

Thus Nature seems to have fitted these animals with appetites and powers of an inferior kind; and formed them for a sort of passive existence in the obscure and heavy element to which they are consigned. To preserve their own existence, and to continue it to their posterity, fill up the whole circle of their pursuits and enjoyments; to these they are impelled rather by necessity than choice, and seem mechanically excited to every fruition. Their senses are incapable of making any distinctions; but they drive forward in pursuit of whatever they can swallow, conquer, or enjoy.

A ceaseless desire of food seems to give the ruling impulse to all their motions. This appetite impels them to encounter every danger; and their rapacity seems insatiable. When taken out of the water, and almost expiring, they greedily swallow the bait by which they were allured to destruction.

The maw is, in general, placed next the mouth, and though possessed of no sensible heat, is endued with a surprising faculty of digestion. This seems, in some measure, to increase with the quantity of food it is supplied with; a single pike having been known to devour a hundred roaches in three days, its faculties also are as extraordinary; for it digests not only fish, but harder substances; prawns, crabs, and lobsters, shells and all. These the cod or the sturgeon will not only devour, but dissolve down, though their shells are so much harder than the sides of the stomach which contains them. This amazing faculty in the cold maw of fishes, has justly excited the curiosity of philosophers; and effectually overturned the system of those, who supposed that the heat of the stomach was alone a sufficient instrument for digestion. The truth seems to be, and some experiments of the skilful Dr. Hunter seem to evince, that there is a power of animal assimilation lodged in the stomach of all creatures, which we can neither describe nor define, converting the substances they swallow into a fluid fitted for their own peculiar support. This is done neither by trituration, nor by warmth, nor by motion, nor by a dissolving fluid, nor by their united efforts: but by some principle in the stomach yet unknown, which acts in a different manner from all kinds of artificial maceration. The meat taken into the stomach or maw is often seen, though very near being digested, still to retain its original form; and ready for a total dissolution, while it appears to the eye as yet untouched by the force of the stomach. This animal power is lodged in the maw of fishes in a greater degree than in any other creatures; their digestive powers are quick, and their appetites are ever craving.

Yet though fish are thus hungry, and constantly prowling, no animals can suffer the want of food for so long a time. The gold and silver fish we keep in vases, seem never to want any nourishment at all; whether it be that they feed on the water insects, too minute for our observation, or that water alone is a sufficient supply, is not evident; but they are often seen for months without apparent sustenance. Even the pike, the most voracious of fishes, will live in a pond where there is none but himself; and, what is more extraordinary, will be often found to thrive there.

Still fish are of all other animals the most voracious and insatiable. Whatever any of them is able to swallow, possessed of life, seems to be considered as desirable food. Some that have small mouths feed upon worms and the spawn of other fish; others, whose mouths are larger, seek larger prey; it matters not of what kind, whether of another or their own. Those with the largest mouths pursue almost every thing that has life; and often meet each other in fierce opposition, when the fish with the largest swallow comes off victorious, and devours its antagonist.

Thus are they irritated by the continual desire of satisfying hunger; and the life of a fish, from the smallest to the greatest, is but one scene of hostility, violence, and evasion. The smaller fry stand no chance in the unequal combat; and their usual way of escaping is by swimming into those shallows where the greater are unable, or too heavy to pursue. There they become invaders in turn, and live upon the spawn of larger fish, which they find floating upon the surface of the water: yet there are dangers attending them in every place. Even in the shallows, the muscle, the oyster, and the scallop, lie in ambush at the bottom, with their shells open, and whatever little fish inadvertently approaches into contact, they at once close their shells upon, and devour the prey at leisure.

Nor is the pursuit of fishes, like that of terrestrial animals, confined to a single region, or to one effort: shoals of one species follow those of another through vast tracts of ocean, from the vicinity of the pole even to the equator. Thus the cod, from the banks of Newfoundland, pursues the whiting, which flies before it to the south of Spain. The cachalot, in the same manner, pursues a shoal of herrings, and swallows thousands at a gulp.

This may be one cause of the annual migrations of fishes from one part of the ocean to the other; but there are other motives which come in aid of this also. Fishes may be induced to change the place of their residence, for one more suited to their constitutions, or more adapted to depositing their spawn. It is remarkable that no fish are fond of very cold waters, and generally frequent those places where it is warmest. Thus, in summer, they are seen in greatest numbers in the shallows near the shore, where the sun has power to warm the water to the bottom; on the contrary, in winter, they are found towards the bottom, in the deep sea; for the cold of the atmosphere is not sufficiently penetrating to reach them at those great depths. Cold produces the same effect upon fresh water fishes; and when they are often seen dead after severe frosts, it is most probable that they have been killed by the severity of the cold, as well as by being excluded by the ice from the air.

All fish live in the water; yet they all stand in need of air for their support. Those of the whale kind, indeed, breathe the air in the same manner as we do, and come to the surface every two or three minutes to take a fresh inspiration; but those which continue entirely under water, are yet under a necessity of being supplied with air, or they will expire in a few minutes. We sometimes see all the fish of a pond killed, when the ice every where covers the surface of the water, and keeps off the air from the subjacent fluid. If a hole be made in the ice, the fish will be seen to come all to that part, in order to take the benefit of a fresh supply. Should a carp, in a large vase of water, be placed under an air-pump, and then be deprived of its air, during the operation a number of bubbles will be seen standing on the surface of the fish's body; soon after the animal will appear to breathe swifter and with greater difficulty; it will be seen to rise towards the surface, to get more air; the bubbles on its surface begin to disappear; the belly that was before swollen, will suddenly fall, and the animal sinks expiring and convulsed at the bottom.

So necessary is air to all animals, but particularly to fish, that they can live but a few minutes without it; yet nothing is more difficult to be accounted for than the manner in which they obtain this supply. Those who have seen a fish in water, must remember the motion of its lips and its gills, or at least of the bones on each side that cover them. This motion in the animal is, without doubt, analogous to our breathing; but it is not air, but water, that the fish actually sucks in and spouts out through the gills at every motion. The manner of its breathing is thus: the fish first takes a quantity of water by the mouth, which is driven to the gills; these close and keep the water so swallowed from returning by the mouth; while the bony covering of the gills prevents it from going through them, until the animal has drawn the proper quantity of air from the body of water thus imprisoned: then the bony covers open, and give it a free passage; by which means also the gills again are opened, and admit a fresh quantity of water. Should the fish be prevented from the free play of its gills, or the bony covers be kept from moving, by a string tied round them, the animal would soon fall into convulsions and die.

But though this be the general method of explaining respiration in fishes, the difficulty remains to know what is done with this air, which the fish in this manner separates from the water. There seems no receptacle for containing it; the stomach being the chief cavity within the body, is too much filled with aliment for that purpose. There is indeed a cavity, and that a pretty large one, the air-bladder or swim, which may serve to contain it for vital purposes; but that our philosophers have long assigned to a different use; namely, the enabling the fish to rise or sink in the water at pleasure, as that is dilated or compressed. The use assigned by the ancients for it was to come in aid of the lungs, and to remain as a kind of storehouse of air to supply the animal in its necessities. I own my attachment to this last opinion; but let us exhibit both with their proper share of evidence, and the reader must be left to determine.

The air-bladder is described as a bag filled with air, sometimes composed of one, sometimes of two, and sometimes of three divisions, situated towards the back of the fish, and opening into the maw or the gullet. Those who contend that this bag is designed for raising or depressing the fish in the water, build upon the following experiment: a carp being put into the air-pump, and the air exhausted, the bladder is said to expand itself to such a degree, that the fish swells in an extraordinary manner, till the bladder bursts, and then the fish sinks, and ever after continues to crawl at the bottom. On another occasion the air-bladder was pricked and wounded, which let out its air; upon which the fish sunk to the bottom, and was not seen to rise after. From thence it is inferred, that the use of the air-bladder must be by swelling, at the will of the animal, thus to increase the surface of the fish's body, and thence diminishing its specific gravity, to enable it to rise to the top of the water, and keep there at pleasure. On the contrary, when the fish wants to descend, it is, say they, but to exhaust this bladder of its air; and the fish being thus rendered slimmer and heavier, consequently sinks to the bottom.

Such is the account given of the use of the air-bladder; no part of which seems to me well supported. In the first place, though nothing is more certain, than that a carp put into the air-pump will swell, yet so will a mouse or a frog; and these we know have no air-bladders. A carp will rise to the surface: but so will all fish that want air, whether they have an air-bladder or not. The air-bladder is said to burst in the experiment; but that I deny. The air-bladder is indeed found empty, but it has suffered no laceration, and may be distended by being blown into, like any other bladder that is sound. The fish, after the experiment, I grant, continues to creep at the bottom; and so will all fish that are sick and wounded, which must be the case with this after such an operation. Thus these facts prove nothing, but that when the fish is killed in an air-pump the air-bladder is found exhausted, and that it will naturally and necessarily be; for the drain of air by which the fish is supplied in the natural way will necessarily oblige it to make use of all its hidden stores; and as there is a communication between the gullet and the air-bladder, the air which the latter contains will thus be obviously drawn away. But still farther, how comes the air-bladder, according to their hypothesis, to swell under the experiment of the air-pump? What is it that closes the aperture of that organ in such a manner as at last to burst it? or what necessity has the fish for dilating it to that violent degree? At most it only wants to rise to the surface; and that the fish can easily do without so great a distention of the air-bladder. Indeed, it should rather seem, that the more the air was wanted without, the less necessity there was for its being uselessly accumulated within; and to make the modern system consistent, the fish under the air-pump, instead of permitting its bladder to be burst, would readily give up its contents; which, upon their supposition, all can do at pleasure.

But the truth is, the fish can neither increase or diminish the quantity of air in its air-bladder at will, no more than we can that which is contained in our stomachs. The animal has no one muscle, much less pair of muscles, for contracting or dilating this organ; its aperture is from the gullet; and what air is put into it must remain there till the necessities, and not the will, of the animal call it forth as a supply.

But to put the matter past a doubt, many fish are furnished with an air-bladder that continually crawl at the bottom; such as the eel and the flounder; and many more are entirely without any bladder, that swim at ease in every depth; such as the anchovy and fresh water gudgeon. Indeed the number of fish that want this organ is alone sufficient proof that it is not so necessary for the purposes of swimming; and as the ventral fins, which in all fish lie flat upon the water, seem fully sufficient to keep them at all depths, I see no great occasion for this internal philosophical apparatus for raising and depressing them. Upon the whole, the air-bladder seems adapted for different purposes than that of keeping the fish at different depths in the water; but whether it be to supply them with air when it is wanted from without, or for what other purpose, I cannot determine.

Hitherto we have seen a fish in every respect inferior to land animals; in the simplicity of their conformation, senses, and enjoyments; but of that humble existence which they have been granted by nature, they have a longer term than any other class of animated nature. ‘Most of the disorders incident to mankind,’ says Bacon, ‘arise from the changes and alterations of the atmosphere; but fishes reside in an element little subject to change; theirs is an uniform existence; their movements are without effort, and their life without labour. Their bones also, which are united by cartilages, admit of indefinite extension; and the different sizes of animals of the same kind among fishes is very various. They still keep growing; their bodies, instead of suffering the rigidity of age, which is the cause of natural decay in land animals, still continue increasing with fresh supplies; and as the body grows, the conduits of life furnish their stores in greater abundance. How long a fish, that seems to have scarce any bounds put to its growth, continues to live, is not ascertained; perhaps the life of a man would not be long enough to measure that of the smallest.’

There have been two methods devised for determining the age of fishes, which are more ingenious than certain; the one is by the circles of the scales, the other by the transverse section of the back-bone. The first method is this: when a fish's scale is examined through a microscope, it will be found to consist of a number of circles, one circle within another, in some measure resembling those which appear upon the transverse section of a tree, and supposed to offer the same information. For as in trees we can tell their age by the number of their circles, so in fishes we can tell them by the number of their circles in every scale, reckoning one ring for every year of the animal's existence. By this method M. Buffon found a carp, whose scales he examined, to be not less than a hundred years old; a thing almost incredible, had we not several accounts in other authors which tend to confirm the discovery. Gesner brings us an instance of one of the same age; and Albertus of one more than double that period.

The age of the skate and the ray, that want scales, may be known by the other method; which is, by separating the joints of the back-bone, and then minutely observing the number of rings, which the surface where it was joined exhibits. By this the fish's age is said to be known; and perhaps with as much certainty as in the former instance.

But how unsatisfactory soever these marks may be, we have no reason to doubt the great ages of some fishes. Those that have ponds, often know the oldest by their superior size. But the longevity of these animals is nothing when compared to their fecundity. All sorts, a few of the larger ones excepted, multiply their kind, some by hundreds, and some by millions. There are some that bring forth their young alive, and some that only produce eggs: the former are rather the least fruitful: yet even these are seen to produce in great abundance. The viviparous blenny, for instance, brings forth two or three hundred at a time, all alive and playing round the parent together. Those who exclude their progeny in a more imperfect state, and produce eggs, which they are obliged to leave to chance, either on the bottom at the edge of the water, or floating on the surface where it is deeper, are all much more prolific; and seem to proportion their stock to the danger there is of its consumption. Of these eggs thus deposited, scarce one in a hundred brings forth an animal; they are devoured by all the lesser fry that frequent the shores; by aquatic birds near the margin, and by the larger fish in deep water. Still, however, there are enough for supplying the deep with inhabitants; and, notwithstanding their own rapacity, and that of fowls of various tribes, the numbers that escape are sufficient to relieve the wants of a very considerable part of mankind. Indeed, when we consider the numbers that a single fish is capable of producing, the amount will seem astonishing. If, for instance, we should be told of a being so very prolific, that in a single season it could bring forth as many of its kind as there are inhabitants in England, it would strike us with surprise; yet a single cod produces full that number. The cod spawns in one season, as Lewenhoeck assures us, above nine millions of eggs or peas contained in one single roe. The flounder is commonly known to produce above one million; and the mackarel above five hundred thousand. Such an amazing increase, if permitted to come to maturity, would overstock nature, and even the ocean itself would not be able to contain, much less to provide for, the half of its inhabitants. But two wise purposes are answered by this increase; it preserves the species in the midst of enemies, and furnishes the rest with a sustenance adapted to their nature.

Fishes seem, all except the whale-kind, divested of those parental solicitudes which mark the manners of the more perfect terrestrial animals.

Fish have different seasons for depositing their spawn: some, that live in the depths of the ocean, are said to choose the winter months; but, in general, those with which we are acquainted, choose the hottest months in summer, and prefer such water as is somewhat tepified by the beams of the sun. They then leave the deepest parts of the ocean, which are the coldest, and shoal round the coast, or swim up the fresh-water rivers, which are warm as they are comparatively shallow. When they have deposited their burdens, they then return to their old stations, and leave their nascent progeny to shift for themselves.

The spawn continues in its egg-state in some fish longer than in others, and this in proportion to the animal's size. In the salmon, for instance, the young animal continues in the egg from the beginning of December till the beginning of April; the carp continues in the egg not above three weeks; the little gold fish from

China, is produced still quicker. These all, when excluded, at first escape by their minuteness and agility. They rise, sink, and turn much readier than grown fish; and they can escape into very shallow waters when pursued. But, with all their advantages, scarcely one in a thousand survives the numerous perils of its youth. The male and female that have given them birth, are equally formidable with the rest, forgetting all relation at their departure.

Such is the general picture of these heedless and hungry creatures: but there are some in this class, living in the waters, that are possessed of finer organs and higher sensations; that have all the tenderness of birds or quadrupeds for their young; that nurse them with care, and protect them from injury. Of this class are the *cetaceous* tribe, or the fishes of the whale kind. There are others, though not capable of nursing their young, yet that bring them alive into the world, and defend them with courage and activity. These are the *cartilaginous* kinds, or those who have gristles instead of bones. But the fierce tribe we have been describing, that leave their spawn without protection, are called the *spinous* or bony kinds, from their bones resembling the sharpness of thorns.

Thus there are three grand divisions in the fish kind: the *cetaceous*, the *cartilaginous*, and the *spinous;* all differing from each other in their conformation, appetites, bringing forth, and education of their young. These three great distinctions are not the capricious differences formed by a maker of systems, but are strongly and firmly marked in Nature. These are the distinctions of Aristotle; and they have been adopted by mankind ever since his time. It will be necessary, therefore, to give the history of each of these in particular; and then to range under each head, those fishes whose history is the most remarkable; or, more properly speaking, those of which we have any history.

Much, indeed, can be said of them if considered relatively to man; and large books have been written of the manner of taking fish; or of dressing them. Apicius is noted for having first taught mankind to suffocate fish in Carthaginian pickle; and Quin, for giving a sauce to the johndoré; Mrs. Glass is famous for the eel pie, and Mr. Tull for his invention of spaying carp, to give it a finer flavour. In this manner our cooks handle the subject. On the other hand, our physicians assure us that the flesh of fishes yield little nourishment, and soon corrupts; that it abounds in a gross sort of oil and water, and hath but a few volatile particles, which renders it less fit to be converted into the substance of our bodies. They are cold and moist, and must needs, say they, produce juices of the same kind, and consequently are improper to strengthen the body. In this diversity of opinion, it is the wisest way to eat our fish in the ordinary manner, and pay no attention to cooks or doctors.

I cannot conclude this chapter without putting a question to the learned, which, I confess, I am not able to resolve. How comes it that fish, which are bred in a salt element, have yet no salt to the taste, or that is capable of being extracted from them?

OF CETACEOUS FISHES IN GENERAL.

As on land there are some orders of animals that seem formed to command the rest, with greater powers and more various instincts, so in the ocean there are fishes which seem formed upon a nobler plan than others, and that, to their fishy form, join the appetites and the conformation of quadrupeds. These are all of the *cetaceous* kind; and so much raised above their fellows of the deep, in their appetites and instincts, that almost all our modern naturalists have excluded them from the finny tribes, and called them, *great beasts of the ocean.* With them it would be as improper to say men go to Greenland fishing for whale, as it would be to say that a sportsman goes to Blackwall a fowling for mackarel.

Yet, notwithstanding philosophers, mankind will always have their own way of talking; and, for my own part, I think them here in the right. A different formation of the lungs, stomach, and intestines; a different manner of breathing or propagating, are not sufficient to counterbalance the great analogy which these animals bear to the whole finny tribe. They are shaped as other fishes; swim with fins; are entirely naked, without hair; live in the water, but come up to breathe; they are only seen in the depths of the ocean, and never come upon shore but when forced thither. These are sufficient to plead in favour of the general denomination, and acquit mankind of error in ranking them with their lower companions of the deep.

But still they are as many degrees raised above other fishes in their nature, as they are in general in their size. This tribe is composed of the whale and its varieties, of the Cachalot, the Dolphin, the Grampus, and the Porpesse.—All these resemble quadrupeds in their internal structure, and in some of their appetites and affections. Like quadrupeds, they have lungs, a midriff, a stomach, intestines, liver, spleen, bladder, and generative parts; their heart also resembles that of quadrupeds, with its partitions closed up as in them, and driving red and warm blood in circulation through the body. In short, every internal part bears a striking similitude; and to keep these parts warm, the whole kind are covered between the skin and the muscles with a thick coat of fat or blubber, which, like the bacon-fat of a hog, keeps out the cold, renders their muscles pliant, and probably makes them swim lighter.

As these animals breathe the air, it is obvious that they cannot bear to be long under water. They are constrained, therefore, every two or three minutes, to come up to the surface to take breath, as well as to spout out through their nostril (for they have but one) that water which they sucked in while gaping for their prey. This conduit, by which they breathe, and also throw out the water, is placed in the head, a little before the brain.—Though externally the hole is but single, it is internally divided by a bony partition, which is closed by a sphincter muscle on the inside, that, like the mouth of a purse, shuts it up at the pleasure of the animal. There is also another muscle or valve, which prevents the water from going down the gullet. When, therefore, the animal takes in a certain quantity, which is necessary to be discharged and separated from its food, it shuts the mouth, closes the valve of the stomach, opens the sphincter that kept the nostril closed, and then breathing strongly from the lungs, pushes the water out by the effort, as we see it rise by the pressure of air in a fire-engine.

The senses of these animals seem also superior to those of other fishes. The eyes of other fishes we have observed, are covered only with that transparent skin that covers the rest of the head; but in all the cetaceous kinds it is covered by eye-lids, as in man. This, no doubt, keeps that organ in a more perfect state, by giving it intervals of relaxation, in which all vision is suspended. The other fishes, that are for ever staring, must see, if for no other reason, more feebly, as their organs of sight are always exerted.

As for hearing these also are furnished with the internal instruments of the ear, although the external orifice nowhere appears. It is most probable that this orifice may open by some canal, resembling the Eustachian tribe, into the mouth; but this has not as yet been discovered.

Yet nature sure has not thus formed a complete apparatus for hearing, and denied the animal the use of it when formed. It is most likely that all animals of the cetaceous kind can hear, as they certainly utter sounds, and bellow to each other. This vocal power would be as needless to animals naturally deaf, as glasses to a man that was blind.

But it is in the circumstances in which they continue their kind, that these animals show an eminent superiority. Other fish deposit their spawn, and leave the success to accident: these never produce above one young, or two at the most; and this the female suckles entirely in the manner of quadrupeds, her breasts being placed, as in the human kind, above the navel.

The whale or the grampus are terrible at any time; but are fierce and desperate in defence of their young. In Waller's beautiful poem of the Summer Islands we have a story, founded upon fact, which shows the maternal tenderness of these animals for their offspring. A whale and her cub had got into an arm of the sea, where, by the desertion of the tide, they were inclosed on every side. The people from shore soon saw their situation, and drove down upon them in boats, with such weapons as the urgent occasion offered. The two animals were soon wounded in several places, and the whole sea round was tinctured with their blood. The whales made several attempts to escape; and at last the old one, by its superior strength, forced over the shallow into the depths of the ocean. But though in safety herself she could not bear the danger that awaited her young one; she therefore rushed in once more where the smaller animal was imprisoned, and resolved, when she could not protect, at least to share its danger. The story ends with poetical justice; for the tide coming in brought off both in safety from their enemies, though not without sustaining an infinite number of wounds in every part.

As to the rest, the distinctive marks of this tribe are, that the number of their fins never exceeds three; namely, two pectoral fins, and one back fin; but in some sorts the last is wanting. These fins differ much from those of other fishes, which are formed of straight spines; the fins of the cetaceous tribe are made up of bones and muscles; and the skeleton of one of their fins greatly resembles the skeleton of a man's hand. Their tails also are different from those of all other fish; they are placed so as to lie flat on the surface of the water; while the other kinds have them, as we every day see, upright or edgeways. This flat position of the tail in cetaceous animals enables them to force themselves suddenly to the surface of the water to breathe, which they are continually constrained to do.

Of these enormous animals some are without teeth, and properly called whales; others have the teeth only in the lower jaw, and are called, by the French, cachalots: the narwhale has teeth only in the upper jaw: the dolphin's teeth, as well as those of the porpesse and grampus, are both above and below. These are the marks that serve to distinguish the kinds of this enormous tribe from each other; and these shall serve to guide us in giving their history.

OF THE WHALE, PROPERLY SO CALLED, AND ITS VARIETIES.

If we compare land animals, in respect to magnitude, with those of the deep, they will appear contemptible. It is probable indeed, that quadrupeds once existed much larger than we now find them. From the skeletons of some that have been dug up at different times, it is evident, that there must have been terrestrial animals twice as large as the elephant; but creatures of such an immense bulk required a proportionable extent of ground for subsistence, and by being rivals with men for large territory, they must have been destroyed in the contest.

But it is not only upon land that man has exerted his power of destroying the larger tribes of animated nature, he has extended his efforts even in the midst of the ocean, and has cut off numbers of those enormous animals that had, perhaps, existed for ages. We now no longer hear of whales two hundred, and two hundred and fifty feet long, which we are certain were often seen about two centuries ago. They have all been destroyed by the skill of mankind, and the species is now dwindled into a race of diminutive animals, from thirty to about eighty feet long.

The northern seas were once the region to which the greatest of these animals resorted; but so great has been the slaughter of whales for more than two ages, that they begin to grow thinner every day; and those that are found there, seem, from their size, not come to their full dimensions. The greatest whales resort to places where they have the least disturbance; to those seas that are on the opposite side of the globe, near the south pole. In that part of the world, there are still to be seen whales that are above a hundred and sixty feet long; and perhaps even longer might be found in those latitudes near the south pole, to which we have not as yet directed our course.

But taking the whale, at the ordinary size of eighty feet long and twenty feet high, what an enormous animated mass must it appear to the spectator! With what amazement must it strike him, to behold so great a creature gamboling in the deep, with the ease and agility of the smallest animal, and making its way with incredible swiftness! This is a sight very common to those who frequent the northern or southern ocean. Yet though this be wonderful, perhaps still greater wonders are concealed in the deep, which we have not had opportunities of exploring.

The whale is the largest animal of which we have any certain information; and the various purposes to which, when taken, its different parts are converted, have brought us tolerably acquainted with its history. Of the whale, properly so called, there are no less than seven different kinds; all distinguished from each other by their external figure, or internal conformation. The great Greenland whale, without a back-fin, and black on the back; the Iceland whale, without a back-fin, and whitish on the back; the New England whale, with a hump on the back; the whale with six humps on the back; the fin-fish, with a fin on the back near the tail; the pike-headed whale, and the round-lipped whale.—All these differ from each other in figure, as their names obviously imply. They differ also in their manner of living; the fin-fish having a larger swallow than the rest, being more active, slender, and fierce, and living chiefly upon herrings. However, they are none of them very voracious; and, if compared to the cachalot, that enormous tyrant of the deep, they appear harmless and gentle. The history of the rest, therefore, may be comprised under that of the great common Greenland whale, with which we are best acquainted.

The great Greenland whale is the fish, for taking which there are such preparations made in different parts of Europe. It is a large, heavy animal, and the head alone makes a third of its bulk. It is usually found from sixty to seventy feet long. The fins on each side are from five to eight feet, composed of bones and muscles, and sufficiently strong to give the great mass of body which they move, speed and activity. The tail, which lies flat on the water, is above twenty-four feet broad; and, when the fish lies on one side, its blow is tremendous. The skin is smooth and black, and in some places marbled with white and yellow; which, running over the surface, has a very beautiful effect. This marbling is particularly observable in the fins and the tail.

The whale makes use only of the tail to advance itself forward in the water. This serves as a great oar to push its mass along; and it is surprising to see with what force and celerity its enormous bulk cuts through the ocean. The fins are made use of for turning in the water, and giving a direction to the velocity impressed by the tail. The female also makes use of them, when pursued, to bear off her young, clapping them on her back, and supporting them by the fins on each side from falling.

The outward or scarf skin of the whale is no thicker than parchment; but this removed, the real skin appears, of about an inch thick, and covering the fat or blubber that lies beneath: this is from eight to twelve inches in thickness; and when the fish is in health, is of a beautiful yellow. The muscles lie beneath; and these, like the flesh of quadrupeds, are red and tough.

The cleft of the mouth is above twenty feet long, which is nearly one third of the animal's whole length; and the upper jaw is furnished with barbs, that lie, like the pipes of an organ, the greatest in the middle, and the smallest to the sides. These compose the whalebone; the longest spars of which are found to be not less than eighteen feet; the shortest, being of no value, are thrown away. The tongue is almost immovably fixed to the lower jaw, seeming one great lump of fat; and, in fact, it fills several hogsheads with blubber. The eyes are not larger than those of an ox; and when the crystaline humour is dried, it does not appear larger than a pea. They are placed towards the back of the head, being the most convenient situation for enabling them to see both before and behind; as also to see over them, where their food is principally found. They are guarded by eye-lids and eye-lashes, as in quadrupeds; and they seem to be sharp-sighted.

Nor is their sense of hearing in less perfection; for they are warned at great distances of any danger preparing against them. It would seem as if nature had designedly given them these advantages, as they multiply little, in order to continue their kind. It is true, indeed, that the external organ of hearing is not preceptible, for this might only embarrass them in their natural element: but as soon as the thin scarf-skin is removed, a black spot is discovered behind the eye, and under that is the auditory canal, that leads to a regular apparatus for hearing. In short, the animal hears the smallest sounds at great distances, and at all times, except when it is spouting water; at which time the fishers approach to strike it.

These spout-holes or nostrils, in all the cetaceous tribe, have been already described: in this whale there are two, one on each side the head before the eyes, and crooked, somewhat like the holes on the belly of a violin. From these holes this animal blows the water fiercely, and with such a noise that it roars like a hollow wind, and may be heard at three miles distance. When wounded it blows more fiercely than before, so that it sounds like the roaring of the sea in a great storm.

We have already observed, that the substance called whalebone, is taken from the upper jaw of the animal, and is different from the real bones of the whale. The real bones are hard, like those of great land animals, are porous, and filled with marrow. Two great strong bones sustain the under lip, lying against each other in the shape of a half-moon: some of these are twenty feet long; they are seen in several gardens set up against each other, and are usually mistaken for the ribs of this animal.

Such is the general conformation and figure of this great inhabitant of the deep, the precise anatomy of which has not been ascertained. In those places where they are caught in abundance, the sailors are not very curious as to the structure of the viscera; and few anatomists care to undertake a task, where the operator, instead of separating with a lancet, must cut his way with an ax. It is as yet doubted, therefore, whether the male, that in most points internally resembles a quadruped, may not have one great bowel fitted entirely for the reception of air, to supply it, when constrained to keep longer than usual at the bottom.

Their fidelity to each other exceeds whatever we are told of, even the constancy of birds. Some fishers, as Anderson informs us, having struck one of two whales, a male and a female, that were in company together, the wounded fish made a long and a terrible resistance: it struck down a boat with three men in it, with a single blow of the tail, by which all went to the bottom. The other still attended its companion, and lent it every assistance; till, at last, the fish that was struck, sunk under the number of its wounds; while its faithful associate, disdaining to survive the loss, with great bellowing, stretched itself upon the dead fish, and shared its fate.

The whale goes with young nine or ten months, and is then fatter than usual, particularly when near the time of bringing forth. It is said that the embryo, when first perceptible, is about seventeen inches long, and white; but the cub, when excluded, is black, and about ten feet long. She generally produces one young one, and never above two. When she suckles her young, she throws herself on one side on the surface of the sea, and the young one attaches itself to the teat. The breasts are two, generally hid within the belly; but she can produce them at pleasure, so as to stand forward a foot and a half, or two feet; and the teats are like those of a cow. In some, the breasts are white; in others speckled; in all filled with a large quantity of milk, resembling that of land animals.

Nothing can exceed the tenderness of the female for her offspring; she carries it with her wherever she goes, and when hardest pursued, keeps it supported between her fins. Even when wounded, she still clasps her young one; and when she plunges to avoid danger, takes it to the bottom; but rises sooner than usual, to give it breath again.

The young ones continue at the breast for a year; during which time, they are called by the sailors, *short-heads.* They are then extremely fat, and yield above fifty barrels of blubber The mother, at the same time, is equally lean and emaciated. At the age of two years they are called *stunts,* as they do not thrive much immediately after quitting the breast; they then scarcely yield above twenty, or twenty-four, barrels of blubber: from that time forward, they are called *skull-fish,* and their age is wholly unknown.

Every species of whale propagates only with those of its own kind, and does not at all mingle with the rest; however, they are generally seen in shoals, of different kinds together, and make their migrations in large companies, from one ocean to another. They are a gregarious animal, which implies their want of mutual defence against the invasions of smaller, but more powerful, fishes. It seems astonishing, therefore, how a shoal of these enormous animals find substance together, when it would seem that the supplying even one with food would require greater plenty than the ocean could furnish. To increase our wonder, we not only see them herding together, but usually find them fatter than any other animals of whatsoever element. We likewise know that they cannot swallow large fishes, as their throat is so narrow, that an animal larger than a herring could not enter. How then do they subsist and grow so fat?—A small insect, which is seen floating in those seas, and which Linnæus terms the Medusa, is sufficient for this supply. These insects are black, and of the size of a small bean, and are sometimes seen floating in clusters on the surface of the water. They are of a round form, like snails in a box, but they have wings, which are so tender, that it is hardly possible to touch them without breaking. These serve rather for swimming than flying; and the little animal is called by the Icelanders, the Walfischoas, which signifies the whale's provender. They have the taste of raw muscles, and have the smell of burnt sugar. These are the food of the whale, which it is seen to draw up in great numbers with its huge jaws, and to bruise between its barbs, which are always found with several of these sticking among them.

This is the simple food of the great Greenland whale; it pursues no other animal, leads an inoffensive life in its element, and is harmless in proportion to its strength to do mischief. There seems to be an analogy between its manners and those of the elephant. They are both the strongest and the largest animals in their respective elements; neither offer injury, but are terrible when provoked. The fin-fish indeed, in some measure, differs from the great whale in this particular, as it subsists chiefly upon herrings, great shoals of which it is often seen driving before it. Yet even the swallow of this fish is not very large, if compared to the cachalot tribe; and its ravages are but sports in comparison. The stomach and intestines of all these animals when opened seldom have any thing in them, except a soft unctuous substance of a brownish colour; and their excrements are of a shining red.

As the whale is an inoffensive animal, it is not to be wondered that it has many enemies, willing to take advantage of its disposition and inaptitude for combat. There is a small animal of the shell-fish kind, called the whale-louse, that sticks to its body, as we see shells sticking to the foul bottom of a ship. This insinuates itself chiefly under the fins; and whatever efforts the great animal makes, it still keeps its hold and lives upon the fat, which it is provided with instruments to arrive at.

The sword-fish is the whale's most terrible enemy. 'At the sight of this little animal,' says Anderson, 'the whale seems agitated in an extraordinary manner; leaping from the water, as if with affright: wherever it appears, the whale perceives it at a distance, and flies from it in the opposite direction. I have been myself,' continues he, 'a spectator of their terrible encounter. The whale has no instrument of defence except the tail; with that it endeavours to strike the enemy; and a single blow taking place would effectually destroy its adversary; but the sword-fish is as active as the other is strong, and easily avoids the stroke; then bounding into the air, it falls upon its great subjacent enemy, and endeavours not to pierce with its pointed beak; but to cut it with its toothed edges. The sea all about is soon dyed with blood, proceeding from the wounds of the whale: while the enormous animal vainly endeavours to reach its invader, and strikes with its tail against the surface of the water, making a report at each blow louder than the noise of a cannon.'

There is still another and more powerful enemy called by the fishermen of New England, the killer. This is itself a cetaceous animal, armed with strong and powerful teeth. A number of these are said to surround the whale, in the same manner as dogs get round a bull. Some attack it with their teeth behind; others attempt it before; until at last the great animal is torn down, and its tongue is said to be the only part they devour when they have made it their prey. They are said to be of such great strength, that one of them alone was known to stop a dead whale that several boats were towing along, and drag it from among them to the bottom.

But of all the enemies of these enormous fishes man is the greatest: he alone destroys more in a year than the rest in an age, and actually has thinned their numbers in that part of the world where they are chiefly sought. The great resort of these animals was found to be on the inhospitable shores of Spitzbergen; where the distance of the voyage, the coldness of the climate, the terrors of the icy sea, and still more, their own formidable bulk, might have been expected to protect them from human injury. But all these were but slight barriers against the arts of man, his courage, and his necessities. The European ships, soon after the improvement of navigation, found the way into those seas; and as early as the beginning of the fourteenth century the Biscayneers possessed a considerable trade to the coasts of Greenland. The Dutch and the English followed their example, and soon took that branch of commerce out of their hands. The English commenced the business about the beginning of the seventeeth century; and the town of Hull had the honour of first attempting that profitable branch of trade. But at present it seems upon the decline, as the quantity of fish are so greatly reduced, by the constant capture for such a vast length of time. It is now said, that the fishers, from a defect of whales, apply themselves to the seal-fishery; yet as these animals are very timorous, they will soon be induced to quit those shores, where they meet such frequent disturbance and danger. The poor natives of Greenland themselves, who used to feed upon the whale, are diminishing, in proportion as their sustenance is removed; and it is probable, that the revolution of a few years will see that extensive coast totally deserted by its inhabitants, as it is already nearly deserted by the whales.

The art of taking whales, like most others, is much improved by time, and differs in many respects from that practised by the Biscayneers, when they first frequented the icy sea. But as the description of their methods is the least complicated, and consequently the easiest understood, it will be best adapted to our purpose.

For this navigation the Biscayneers, in favourable seasons, fitted out thirty ships, of two hundred and fifty tons each, with fifty choice men a piece, and a few boys. These were stored with six months provision; and each ship had its boats, which were to be serviceable when come to the place of duty. When arrived at the part where the whales are expected to pass to the southward, they always keep their sails set, and a sailor is placed at the mast head, to give information when he spies a whale. As soon as he discovers one, the whole crew are instantly in employment: they fit out their boats, and row away to where the whale was seen. The harpooner, who is to strike the fish, stands at the prow of the boat, with an harpoon or javelin in his hand, five or six feet long, pointed with steel like the barb of an arrow, of a triangular shape. As this person's place is that of the greatest dexterity, so also it is the greatest danger: the whale sometimes overturns the boat with a blow of its tail, and sometimes drives against it with fury.

In general, however, the animal seems to sleep on the surface of the water; while the boat is approaching, the harpooner stands aloft, and with his harpoon tied to a cord of several hundred fathoms length, darts it into the animal, and then rows as fast as possible away. It is some time before the whale seems to feel the blow; the instrument has usually pierced no deeper than the fat, and that being insensible, the animal continues for a while motionless; but soon roused from its seeming lethargy, as the shaft continues to pierce deeper and deeper into the muscular flesh, it flies off with amazing rapidity. In the mean time, the harpoon sticks in its side, while the rope, which is coiled up in the boat, and runs upon a swivel, lengthens as the whale recedes, but still shows the part of the deep to which it has retreated. The cord is coiled up with great care; for such is the rapidity with which it runs off, that if it was but the least checked, as it yields with the animals retreat, it would infallibly overset the boat, and the crew would go to the bottom. It sometimes happens also, that the rapidity with which it runs over the swivel at the edge of the boat, heats it, and it would infallibly take fire, did not a man stand continually with a wet mop in his hand, to cool the swivel as the cord runs. The whale having dived to a considerable depth, remains at the bottom, sometimes for near half an hour, with the harpoon in its body, and then rises to take breath, expecting the danger over; but the instant it appears, they are all with their boats ready to receive it, and fling their harpoons into its body; the animal again dives and again rises, while they repeat their blows. The ship follows in full sail, like all the rest, never losing sight of the boats, and ready to lend them assistance; the whole ocean seems dyed in blood. Thus they renew their attack, till the whale begins to be quite enfeebled and spent, when they plunge their longer spears into various parts of its body, and the enormous animal expires. When it is dead, to prevent it from sinking, they tie it with a strong iron chain to the boat, and either cut it up in pieces, and carry it home in that manner, or extract the oil from the blubber on ship-board.

Such is the manner in which these fish were taken in the beginning; but succeeding arts have improved the method, and the harpoon is now thrown by; a machine being used which inflicts a deeper wound, and strikes the animal with greater certainty: there are better methods for extracting the oil, and proper machines for cutting the animal up, than were used in the early fisheries. But as an account of this belongs to the history of art, and not of nature, we must be contented with observing, that several parts of this animal, and all but the intestines and the bones, are turned to very good account; not only the oil, but the greaves from which it is separated. The flesh of this animal is also a dainty to some nations, and even the French seamen are now and then found to dress and use it as their ordinary diet at sea. It is said, by the English and Dutch sailors, to be hard and ill-tasted; but the French assert the contrary; and the savages of Greenland, as well as those near the south-pole, are amazingly fond of it. They eat the flesh and drink the oil, which is a first-rate delicacy. The finding a dead whale is an adventure considered among the fortunate circumstances of their wretched lives. They make their abode beside it; and seldom remove till they have left nothing but the bones.

Jacobson, whom we have quoted before in the history of birds, where he described his countrymen of the island of Feroe as living a part of the year upon salted gulls, tells us also, that they are very fond of salted whale's flesh. The fat of the head they season with bay salt, and then hang it up to dry in the chimney. He thinks it tastes as well as fat bacon; and the lean, which they boil, is, in his opinion, not inferior to beef. Perhaps Jacobson would make but an indifferent taster at one of our city feasts!

OF THE NARWHALE.

From whales that entirely want teeth, we come to such as have them in the upper jaw only; and in this class there is found but one, the narwhale, or sea-unicorn. This fish is not so large as the whale, not being above sixty feet long. Its body is more slender than that of the whale, and its fat not in so great abundance. But this great animal is sufficiently distinguished from all others of the deep by its teeth, which stand pointing directly forward from the upper jaw, and are from nine to fourteen feet long. In all the variety of weapons with which nature has armed her various tribes, there is not one so large or so formidable as this. This terrible weapon is generally found single, and some are of opinion that the animal is furnished but with one by nature;

but there is at present the skull of a narwhale at the Stadthouse at Amsterdam, with two teeth; which plainly proves that in some animals at least this instrument is double. It is even a doubt whether it may not be so in all; and that the narwhale's wanting a tooth is only an accident which it has met with in the encounters it is obliged to be engaged in. Yet it must be owned of those that are taken only with one tooth, there seems no socket for any other upon the opposite side of the jaw, but all is plain and even. However this be, the tooth, or as some are pleased to call it, the horn of the narwhale is the most terrible of all natural instruments of destruction. It is as straight as an arrow, about the thickness of the small of a man's leg, and wreathed in the manner we sometimes see twisted bars of iron; it tapers to a sharp point; and is whiter, heavier, and harder than ivory. It is generally seen to spring from the left side of the head directly forward in a straight line with the body; and its root enters into the socket above a foot and a half. In a skull to be seen at Hamburgh there are two teeth, which are each above seven feet long, and are eight inches in circumference. When the animal, possessed of these weapons, is urged to employ them, it drives directly forward against the enemy with its teeth, that, like protended spears, pierce whatever stands before them.

The length of these instruments has induced some to consider them rather as horns than teeth; but they in every respect resemble the tusks of the boar and the elephant. They grow, as in them, from sockets in the upper jaw; they have the solidity of the hardest bone, and far surpass ivory in all its qualities. The same error has led others to suppose, that as among quadrupeds the female was often found without horns, so these instruments of defence were only to be found in the male; but this has been more than once refuted by experience; both sexes are found armed in this manner; the horn is sometimes found wreathed and sometimes smooth; sometimes a little bent and sometimes straight; but always strong, deeply fixed, and sharply pointed.

Yet notwithstanding all these appointments for combat, these long and pointed tusks, amazing strength, and unmatchable celerity, the narwhale is one of the most harmless and peaceable inhabitants of the ocean. It is seen constantly and inoffensively sporting among the other great monsters of the deep, no way attempting to injure them, but pleased in their company. The Greenlanders call the narwhale the fore-runner of the whale; for wherever it is seen, the whale is shortly after sure to follow. This may arise as well from the natural passion for society in these animals, as from both living upon the same food, which are the insects described in the preceding chapter. These powerful fishes make war upon no other living creature; and though furnished with instruments to spread general destruction, are as innocent and peaceful as a drove of oxen. Nay, so regardless are they of their own weapons, and so utterly unmindful to keep them in repair for engagement, that they are constantly seen covered over with weeds, slough, and all the filth of the sea; they seem rather considered as an impediment than a defence.

The manners and appetites both of the narwhale and the great whale are similar; they both want teeth for chewing, and are obliged to live upon insects; they both are peaceable and harmless, and always rather fly than seek the combat. The narwhale has a much narrower gape than the great whale, and therefore does not want the use of barbs to keep in its food when once sucked into the mouth. It is also much swifter, and would never be taken by the fishermen but for those very tusks which at first appear to be its principal defence. These animals, as was said, being fond of living together, are always seen in herds of several at a time; and whenever they are attacked they crowd together in such a manner that they are mutually embarrassed by their tusks. By these they are often locked together, and are prevented from sinking to the bottom. It seldom happens then, but the fishermen make sure of one or two of the hindmost, which well reward their trouble.

It is from the extraordinary circumstance of the teeth, therefore, that this fish demands a distinct history; and such has been the curiosity of mankind, and their desire to procure them, that a century ago they were considered as the greatest rarity in the world. At that time the art of catching whales was not known; and mankind saw few, except such as were stranded on the coasts by accident. The tooth of the narwhale, therefore, was ascribed to a very different animal from that which really bore it. Among other fossil substances they were sometimes dug up; and the narwhale being utterly unknown, naturalists soon found a terrestrial owner. They were thought to be the horns of unicorns, an animal described by Pliny as resembling a horse, and with one straight horn darting forward from the middle of its forehead. These teeth were, therefore, considered as a strong testimony in favour of that historian's veracity, and were shown among the most precious remains of antiquity. Even for some time after the narwhale was known, the deceit was continued, as those who were possessed of a tooth sold it to great advantage. At present they are too well known to deceive any, and are only shown for what they really are; their curiosity increasing in proportion to their weight and size.

OF THE CACHALOT AND ITS VARIETIES.

The Cachalot, which has generally gone under the name of the spermaceti-whale, till Mr. Pennant very properly made the distinction, by borrowing its name from the

French, has several teeth in the under-jaw, but none in the upper. As there are no less than seven distinctions among whales, so also there are the same number of distinctions in the tribe we are describing. The cachalot with two fins and a black back; the cachalot with two fins and a whitish back; that with a spout in the neck; that with a spout in the snout; that with three fins and sharp pointed teeth; that with three fins and sharp edged teeth; and the cachalot with three fins and flatted teeth.

This tribe is not of such enormous size as the whale, properly so called, not being above sixty feet long, and sixteen feet high. In consequence of being more slender, they are more active than the common whale; they remain a longer time at the bottom; and afford a smaller quantity of oil. As in the common whale the head was seen to make a third part of its bulk, so in this species the head is so large as to make one half of the whole. The tongue of this animal is small, but the throat formidable; and with great ease it could swallow an ox. In the stomach of the whale scarcely any thing is to be found; but in that of the cachalot there are loads of fish of different kinds; some whole, some half-digested, some small, and others eight or nine feet long. The cachalot is, therefore, as destructive among lesser fishes as the whale is harmless; and can at one gulp swallow a shoal of fishes down its enormous gullet. Linnæus tells us that this fish pursues and terrifies the dolphins and porpesses so much, as often to drive them on shore.

But, how formidable soever it may be to its fellows of the deep, it is by far the most valuable, and the most sought after by man, as it contains two very precious drugs, spermaceti and ambergris. The use of these, either for the purposes of luxury or medicine, is so universal, that the capture of this animal that alone supplies them, turns out to great advantage, particularly since the art has been found of converting all the oil of this animal, as well as the brain, into that substance called spermaceti.

This substance, as it is naturally formed, is found in the head of the animal, and is no other than the brain. The outward skin of the head being taken off, a covering of fat offers about three inches thick; and, under that, instead of a bony skull, the animal has only another thick skin that serves for a covering and defence of the brain. The first cavity or chamber of the brain, is filled with that spermaceti which is supposed of the greatest purity and highest value. From this cavity there is generally drawn about seven barrels of the clearest spermaceti, that, thrown upon water coagulates like cheese. Below this there is another chamber just over the gullet, which is about seven feet high; and this also contains the drug, but of less value. It is distributed in this cavity like honey in a hive, in small cells, separated from each other by a membrane like the inner skin of an egg. In proportion as the oily substance is drawn away from this part, it fills anew from every part of the body; and from this is generally obtained about nine barrels of oil.—Besides this, the spinal-marrow, which is about as thick as a man's thigh, and reaches all along the back-bone to the tail, where it is not thicker than one's finger, affords a considerable quantity.

This substance, which is used in the composition of many medicines, rather to give them consistence than efficacy, was at first sold at a high price, both from the virtues ascribed to it, and the small quantity that the cachalot was capable of supplying.

The whole oil of the fish is easily convertible into spermaceti. This is performed by boiling it with a lea of pot-ash, and hardening it in the manner of soap. Candles are now made of it, which are substituted for wax, and sold much cheaper.

As to the ambergris, which is sometimes found in this whale, it was long considered as a substance found floating on the surface of the sea; but time, that reveals the secrets of the mercenary, has discovered that it chiefly belongs to this animal. The name, which has been improperly given to the former substance, seems more justly to belong to this; for the ambergris is found in the place where the seminal vessels are usually situated in other animals. It is found in a bag of three or four feet long, in round lumps from one to twenty pounds weight, floating in a fluid rather thinner than oil, and of a yellowish colour. There are never seen more than four at a time in one of these bags; and that which weighed twenty pounds, and which was the largest ever seen, was found single. These balls of ambergris are not found in all fishes of this kind, but chiefly in the oldest and strongest. The uses of this medicine for the purposes of luxury, and as a perfume, are well known; though upon some subjects ignorance is preferable to information.

OF THE DOLPHIN, THE GRAMPUS, AND THE PORPESSE, WITH THEIR VARIETIES.

All these fish have teeth both in the upper and the lower jaws, and are much less than the whale. The Grampus, which is the largest, never exceeds twenty feet. It may also be distinguished by the flatness of its head, which resembles a boat turned upside down. The Porpesse resembles the grampus in most things except the snout, which is not above eight feet long; its snout also more resembles that of a hog. The Dolphin has a strong resemblance to the porpesse, except that its snout is longer and more pointed. They have all fins on the back; heads very large, like the rest of the whale kind; and resemble each other in their appetites, manners, and conformations; being equally voracious, active, and roving.

The great agility of these animals hinders their often being taken. They seldom remain a moment above water; sometimes, indeed, their too eager pursuits expose them to danger; and a shoal of herrings often allures them out of their depth. In such a case, the hungry animal continues to flounder in the shallows till knocked on the head, or the returning tide comes to its relief. But all this tribe, and the dolphin in particular, are not less swift than destructive. No fish could escape them, but from the awkward position of the mouth, which is placed in a manner under the head: yet, with these disadvantages, their depredations are great, and they have been styled the plunderers of the deep.

What could induce the ancients to a predilection in favour of these animals, particularly the dolphin, it is not easy to account for. At present, dolphins are regarded even by the vulgar in a very different light; their appearance is far from being esteemed a favourable omen by the seamen; and from their boundings, springs, and frolics in the water, experience has taught the mariners to prepare for a storm.

The moderns have more just notions of these animals than the ancients had, and have got over the many fables told by them, which every day's experience contradicts. Indeed their numbers are so great, and, though shy, they are so often taken, that such peculiarities, if they ever possessed any, would have been long since ascertained. They are found, the porpesse especially, in such vast numbers, in all parts of the sea that surrounds this kingdom, that they are sometimes noxious to seamen, when they sail in small vessels. In some places they almost darken the water as they rise to take breath, and particularly before bad weather are much agitated, swimming against the wind, and tumbling about with unusual violence.

Whether these motions be the gambols of pleasure or the agitations of terror, is not well known. It is most probable that they dread those seasons of turbulence, when the lesser fishes shrink to the bottom, and their prey no longer offers in sufficient abundance. In times of fairer weather they are seen herding together, and pursuing shoals of various fish with great impetuosity. Their method of hunting their game, if it may be so called, is to follow in a pack, and thus give each other mutual assistance. At that season when the mackarel, the herring, the salmon, and other fish of passage, begin to make their appearance, the cetaceous tribes are seen fierce in the pursuit; urging their prey from one creek or bay to another, deterring them from the shallows, driving them towards each other's ambush, and using a greater variety of arts than hounds are seen to exert in pursuing the hare. However the porpesse not only seeks for prey near the surface, but often descends to the bottom in search of sand-eels and sea-worms, which it roots out of the sand with its nose. For this purpose, the nose projects a little, is shorter and stronger than that of the dolphin; and the neck is furnished with strong muscles, which enable it the readier to turn up the sand.

But it sometimes happens, that the impetuosity, or the hunger, of these animals, in their usual pursuits, urges them beyond the limits of safety. The fishermen, who extend their long nets for pilchards, on the coasts of Cornwall, have sometimes an unwelcome capture in one of these. Their feeble nets, which are calculated only for taking smaller prey, suffer an universal laceration, from the efforts of this strong animal to escape; and if it be not knocked on the head, before it has had time to flounder, the nets are destroyed, and the fishery interrupted. There is nothing, therefore, they so much dread, as the entangling a porpesse; and they do every thing to intimidate the animal from approaching.

Indeed, these creatures are so violent in the pursuit of their prey, that they sometimes follow a shoal of small fishes up a fresh water river, from whence they find no small difficulty to return. We have often seen them taken in the Thames at London, both above the bridges and below them. It is curious enough to observe with what activity they avoid their pursuers, and what little time they require to fetch breath above the water. The manner of killing them is for four or five boats to spread over the part of the river in which they are seen, and with fire-arms to shoot at them the instant they rise above the water. The fish being thus for some time kept in agitation, requires to come to the surface at quicker intervals, and thus affords the marksmen more frequent opportunities.

When the porpesse is taken, it becomes no inconsiderable capture, as it yields a large quantity of oil; and the lean of some, particularly if the animal be young, is said to be as well tasted as veal. The inhabitants of Norway prepare from the eggs found in the body of this fish, a kind of caviar, which is said to be very delicate sauce, or good when even eaten with bread. There is a fishery for porpesses along the western isles of Scotland during the summer season, when they abound on that shore; and this branch of industry turns to good advantage.

We are told that these animals live to a considerable age; though some say not above twenty-five or thirty years; and they sleep with the snout above water. They seem to possess, in a degree proportioned to their bulk, the manners of whales; and the history of one species of cetaceous animals, will, in a great measure, serve for the whole.

OF CARTILAGINOUS FISHES IN GENERAL.

WE have seen that fishes of the cetaceous kind bear a strong resemblance to quadrupeds in their conformation; those of the cartilaginous kinds are one remove separated from them; they form the shade that completes the imperceptible gradations of nature.

The first great distinction they exhibit is, in having cartilages or gristles instead of bones. The cetaceous tribes have their bones entirely resembling those of quadrupeds, thick, white, and filled with marrow; those of the spinous kind, on the contrary, have small slender bones, with points resembling thorns, and generally solid throughout. Fishes of the cartilaginous nature have their bones always soft and yielding; and age, that hardens the bones of other animals, rather contributes still more to soften theirs. The size of all fishes increases with age; but from the pliancy of the bones in this tribe, they seem to have no bound placed to their dimensions; and it is supposed that they grow larger every day till they die.

They have other differences more obviously discernible. We have observed, that the cetaceous tribes had lungs like quadrupeds, a heart with its partition in the same manner, and apparatus for hearing; on the other hand, we mentioned that the spinous kinds had no organs of hearing, no lungs to breathe through, and no partition in the heart; but that their cold red blood was circulated by means of the impulse made upon their gills by the water. Cartilaginous fishes unite both these systems in their conformation: like the cetaceous tribes, they have organs of hearing, and lungs; like the spinous kinds, they have gills, and a heart without a partition. Thus possessed of a two-fold power of breathing, sometimes by means of their lungs, sometimes by that of their gills, they seem to unite all the advantages of which their situation is capable, and drawing from both elements every aid to their necessities or their enjoyments.

This double capacity of breathing in these animals is one of the most remarkable features in the history of nature. The apertures by which they breathe are somewhere placed about the head; either beneath, as in flat fish: on the sides, as in sharks; or on the top of the head, as in pipe-fish. To these apertures are the gills affixed, but without any bone to open and shut them, as in spinous fishes; from which, by this mark, they may be easily distinguished, though otherwise very much alike in appearance. From these are bending cylindrical ducts, that run to the lungs, and are supposed to convey the air that gives the organs their proper play. But the heart has only one valve; so that their blood wants that double circulation which obtains in the cetaceous kinds; and the lungs seem to me rather as an internal assistant to the gills, than fitted for supplying the same offices as in quadrupeds, for they want the pulmonary vein and artery.

From this structure, however, the animal is enabled to live a longer time out of water than those whose gills are more simple. The cartilaginous shark, or ray, live some hours after they are taken; while the spinous herring or mackarel expire a few minutes after they are brought on shore. From hence this tribe seems possessed of powers that other fishes are wholly deprived of; they can remain continually under water, without ever taking breath; while they can venture their heads above the deep, and continue for hours out of their native element.

The same duplicity of character which marks their general conformation obtains also with regard to their manner of bringing forth. Some bring forth their young alive; and some bring forth eggs, which are afterwards brought to maturity.

Cartilaginous fish may be divided first into those of the shark kind, with a body growing less towards the tail, a rough skin, with the mouth placed far beneath the end of the nose, five apertures on the sides of the neck for breathing, and the upper part of the tail longer than the lower. This class chiefly comprehends the great white shark, balance fish, hound fish, monk fish, dog fish, basking shark, zygæna, tope, cat fish, blue shark, sea fox, smooth hound fish, and porbeagle. These are all of the same nature, and differ more in size than in figure or conformation.

The next division is that of the flat fish; and these, their broad, flat, thin shape is sufficiently capable of distinguishing from all others of this kind. They may be easily distinguished also from spinous flat fish, by the holes through which they breathe, which are uncovered by a bone; and which, in this kind, are five on each side. In this tribe we may place the torpedo, skate, sharp-nosed ray, rough ray, thornback, and fireflare.

The third division is that of the slender snake-shaped kind; such as the lamprey, pride, and pipe fish.

The fourth division is of the sturgeon and its variety, the ising-glass fish.

The last division may comprise fish of different figures and natures, that do not rank under the former divisions. These are the sun fish, tetrodon, lump fish, sea snail, chimæra, and fishing frog. Each of these has somewhat peculiar in its powers or its form, that deserves to be remarked. The description of the figures of these at least may compensate for our general ignorance of the rest of their history.

OF CARTILAGINOUS FISHES OF THE SHARK KIND.

Of all the inhabitants of the deep, those of the shark kind are the fiercest and the most voracious. The smallest of this tribe is not less dreaded by greater fish, than many that to appearance seem more powerful; nor do any of them seem fearful of attacking animals far above their size: but the Great White Shark, which is the largest of the kind, joins to the most amazing rapidity, the strongest appetites for mischief: as he approaches nearly in size to the whale, he far surpasses him in strength and celerity, in the formidable arrangement of his teeth, and his insatiable desire of plunder.

The White Shark is sometimes seen to rank even among whales for magnitude; and is found from twenty to thirty feet long. Some assert that they have seen them of four thousand pounds weight; and we are told particularly of one, that had a human corpse in his belly. The head is large, and somewhat flatted; the snout long, and the eyes large. The mouth is enormously wide, as is the throat, and capable of swallowing a man with great ease. But its furniture of teeth is still more terrible; of these there are six rows, extremely hard, sharp-pointed, and of a wedge-like figure. It is asserted that there are seventy-two in each jaw, which makes an hundred and forty-four in the whole; yet others think that their number is uncertain; and that in proportion as the animal grows older, these terrible instruments of destruction increase. With these, the jaws, above and below, appear planted all over; but the animal has a power of erecting or depressing them at pleasure. When the shark is at rest, they lie quite flat in his mouth; but when he prepares to seize his prey, he erects all this dreadful apparatus, by the help of a set of muscles, that join them to the jaw; and the animal he seizes, dies, pierced with a hundred wounds, in a moment.

Nor is this fish less terrible to behold as to the rest of his form: his fins are larger in proportion; he is furnished with large eyes, that he turns with ease on every side, so as to see his prey behind him as well as before; and his whole aspect is marked with a character of malignity: his skin also is rough, hard, and prickly; being that substance which covers instrument cases, called shagreen.

As the shark is thus formidable in his appearance, so is he also dreadful from his courage and activity. No fish can swim so fast as he; none so constantly employed in swimming: he outstrips the swiftest ships, plays round them, darts out before them, returns, seems to gaze at the passengers, and all the while does not seem to exhibit the smallest symptoms of an effort to proceed. Such amazing powers, with such great appetites for destruction, would quickly unpeople even the ocean, but, providentially, the shark's upper-jaw projects so far above the lower, that he is obliged to turn on one side, (not on his back as is generally supposed,) to seize his prey. As this takes some small time to perform, the animal pursued seizes that opportunity to make its escape.

Still, however, the depredations he commits are frequent and formidable. The shark is the dread of sailors in all hot climates; where, like a greedy robber, he attends the ships, in expectation of what may drop overboard. A man who unfortunately falls into the sea at such a time, is sure to perish, without mercy. A sailor that was bathing in the Mediterranean, near Antibes, in the year 1744, while he was swimming about fifty yards from the ship, perceived a monstrous fish making towards him, and surveying him on every side, as fish are often seen to look round a bait. The poor man, struck with terror at its approach, cried out to his companions in the vessel to take him on board. They accordingly threw him a rope with the utmost expedition, and were drawing him up by the ship's side, when the shark darted after him from the deep, and snapped off his leg.

Mr. Pennant tells us, that the master of a Guinea-ship, finding a rage for suicide prevail among his slaves, from a notion the unhappy creatures had, that after death they should be restored again to their families, friends, and country; to convince them at least that some disgrace should attend them here, he ordered one of their dead bodies to be tied by the heels to a rope, and so let down into the sea; and, though it was drawn up again with great swiftness, yet in that short space, the sharks had bit off all but the feet. Whether this story is prior to an accident of the same kind, which happened at Belfast, in Ireland, about twenty years ago, I will not take upon me to determine; but certain it is, there are some circumstances alike in both, though more terrible in that I am going to relate. A Guinea captain was, by stress of weather, driven into the harbour of Belfast, with a lading of very sickly slaves, who in the manner above-mentioned, took every opportunity to throw themselves overboard when brought up upon the deck, as is usual, for the benefit of the fresh air. The captain perceiving, among others, a woman slave attempting to drown herself, pitched upon her as a proper example to the rest. As he supposed that they did not know the terrors attending death, he ordered the woman to be tied with a rope under the arm-pits, and so let down into the water. When the poor creature was thus plunged in, and about half way down, she was heard to give a terrible shriek, which at first was ascribed to her fears of drowning; but soon after the water appearing red all round her, she was drawn up, and it was found that a shark, which had followed the ship, had bit her off from the middle. The circumstance of Brook Watson losing his leg in the West Indies from the bite of a shark, as he was bathing, is well known.

Such is the frightful rapacity of this animal; nothing that has life is rejected. But it seems to have a peculiar enmity to man: when once it has tasted human flesh, it never desists from haunting those places where it expects the return of its prey. It is even asserted, that along the coasts of Africa, where these animals are found in great abundance, numbers of the negroes, who are obliged to frequent the waters, are seized and devoured by them every year. The people of these coasts are firmly of opinion, that the shark loves the black man's flesh in preference to the white; and that when men of different colours are in the water together, it always makes choice of the former.

However this be, men of all colours are equally afraid of this animal, and have contrived different methods to destroy him. In general, they derive their success from the shark's own rapacity. The usual method of our sailors to take him, is by baiting a great hook with a piece of beef or pork, which is thrown out into the sea by a strong cord, strengthened near the hook with an iron chain. Without this precaution, the shark would quickly bite the cord in two, and thus set himself free. It is no unpleasant amusement to observe this voracious animal coming up to survey the bait, particularly when not pressed by hunger. He approaches it, examines it, swims round it, seems for a while to neglect it, perhaps apprehensive of the cord and the chain; he quits it for a little; but his appetite pressing, he returns again; appears preparing to devour it, but quits it once more. When the sailors have sufficiently diverted themselves with his different evolutions, they then make a pretence by drawing the rope, as if intending to take the bait away; it is then that the glutton's hunger excites him; he darts at the bait, and swallows it, hook and all. Sometimes, however, he does not so entirely gorge the whole, but that he once more gets free; yet even then though wounded and bleeding with the hook, he will again pursue the bait until he is taken. When he finds the hook lodged in his maw, his utmost efforts are then excited, but in vain, to get free; he tries with his teeth to cut the chain; he pulls with all his force to break the line; he almost seems to turn his stomach inside out, to disgorge the hook: in this manner he continues his formidable though fruitless efforts; till quite spent, he suffers his head to be drawn above water, and the sailors, confining his tail by a noose, draw him on shipboard and dispatch him. This is done by beating him on the head till he dies; yet even that is not effected without difficulty and danger; the enormous creature, terrible even in the agonies of death, still struggles with his destroyers; nor is there an animal in the world that is harder to be killed. Even when cut in pieces, the muscles still preserve their motion, and vibrate for some minutes after being separated from the body. Another method of taking him, is by striking a barbed instrument called a fizgig, into his body, as he brushes along by the side of the ship. As soon as he is taken up, to prevent his flouncing, they cut off the tail with an ax, with the utmost expedition.

This is the manner in which Europeans destroy the shark; but some of the negroes along the African coast, take a bolder and more dangerous method to combat their terrible enemy. Armed with nothing more than a knife, the negro plunges into the water, where he sees the shark watching for his prey, and boldly swims forward to meet him; though the great animal does not come to provoke the combat, he does not avoid it, and suffers the man to approach him; but just as he turns upon his side to seize the aggressor, the negro watches the opportunity, plunges his knife into the fish's belly, and pursues his blows with such success, that he lays the ravenous tyrant dead at the bottom: he then fixes the fish's head in a noose, and drags him to shore, where he makes a noble feast for the adjacent villages.

Nor is man the only enemy this fish has to fear: the remora, or sucking fish, is probably a still greater, and follows the shark every where. This fish has got a power of adhering to whatever it sticks against, in the same manner as a cupping-glass sticks to the human body. It is by such an apparatus that this animal sticks to the shark, and drains away its moisture. The seamen, however, are of opinion, that it is seen to attend on the shark for more friendly purposes, to point him to his prey, and apprize him of his danger. For this reason it has been called the shark's pilot.

The shark so much resembles the whale in size, that some have injudiciously ranked it in the class of cetaceous fishes: but its real rank is in the place here assigned it, among those of the cartilaginous kind. It breathes with gills and lungs, its bones are gristly, and it brings forth several living young; Belonius assures us, that he saw a female shark produce eleven live young ones at a time.

Upon the whole, a shark, when living, is a very formidable animal; and, when dead, is of very little value. The flesh is hardly digestible by any but the negroes, who are fond of it to excess; the liver affords three or four quarts of oil; some imaginary virtues have been ascribed to the brain; and its skin is, by great labour, polished into that substance called shagreen. Mr. Pennant is of opinion, that the female is larger than the male in all this tribe; which would, if confirmed by experience, make a striking agreement between them and birds of prey.

OF CARTILAGINOUS FLAT-FISH OF THE RAY KIND.

The same rapacity which impels the shark along the surface of the water, actuates the flat fish at the bottom.

Less active, and less formidable, they creep in security along that part, and seize every thing that comes in their way; neither the hardest shells nor the sharpest spines give protection to the animals that bear them; their insatiable hunger is such, that they devour all; and the force of their stomach is so great, that it easily digests them.

The whole of this kind resemble each other strongly in their figure; nor is it easy, without experience, to distinguish one from another. The stranger to this dangerous tribe may imagine he is only handling a skate, when he is instantly numbed by the torpedo; he may suppose he has caught a thornback, till he is stung by the fireflare. It will be proper, therefore, after describing the general figure of these animals, to mark their differences.

All fish of the ray kind are broad, cartilaginous, swimming flat on the water, and having spines on different parts of their body, or at the tail. They all have their eyes and mouth placed quite under the body, with apertures for breathing either about or near them. They all have teeth, or a rough bone, which answers the same purpose. Their bowels are very wide towards the mouth, and go on diminishing to the tail. The tail is very differently shaped from that of other fishes; and at first sight more resembling that of a quadruped, being narrow, and ending either in a bunch or a point. But what they are chiefly distinguished by, is their spines or prickles, which the different species have on different parts of their body. Some are armed with spines above and below; others have them on the upper part only; some have their spines at the tail; some have three rows of them, and others but one. These prickles in some are comparatively soft and feeble; those of others, strong and piercing. The smallest of these spines are usually inclining towards the tail; the larger towards the head.

It is by the spines that these animals are distinguished from each other. The skate has the middle of the back rough, and a single row of spines on the tail. The sharp-nosed ray has ten spines that are situated towards the middle of the back. The rough ray has its spines spread indiscriminately over the whole back. The thornback has its spines disposed in three rows upon the back. The fireflare has but one spine, but that indeed a terrible one. This dangerous weapon is placed on the tail, about four inches from the body, and is not less than five inches long. It is of a flinty hardness, the sides thin, sharp pointed, and closely and sharply bearded the whole way. The last of this tribe that I shall mention is the torpedo; and this animal has no spines that can wound; but in the place of them it is possessed of one of the most potent and extraordinary faculties in Nature.

Such are the principal differences that may enable us to distinguish animals, some of which are of great use to mankind, from others that are terrible and noxious. With respect to their uses indeed, as we shall soon see, they differ much; but the similitude among them, as to their nature, appetites, and conformation, is perfect and entire. They are all as voracious as they are plentiful; and as dangerous to a stranger, as useful to him who can distinguish their difference.

Of all the larger fish of the sea, these are the most numerous; and they owe their numbers to their size. Except the white shark and cachalot alone, there is no other fish that has a swallow large enough to take them in; and their spines make them a still more dangerous morsel. Yet the size of some is such, that even the shark himself is unable to devour them: we have seen some of them in England weigh above two hundred pounds; but that is nothing to their enormous bulk in other parts of the world. Labat tells us of a prodigious ray that was speared by the negroes at Guadaloupe, which was thirteen feet eight inches broad, and above ten feet from the snout to the insertion of the tail. The tail itself was in proportion, for it was not less than fifteen feet long, twenty inches broad at its insertion, and tapering to a point. The body was two feet in depth; the skin as thick as leather, and marked with spots; which spots, in all of this kind, are only glands, that supply a mucus to lubricate and soften the skin. This enormous fish was utterly unfit to be eaten by the Europeans; but the negroes chose out some of the nicest bits, and carefully salted them up as a most favourite provision.

Yet, large as this may seem, it is very probable that we have seen only the smallest of the kind; as they generally keep at the bottom, the largest of the kind are seldom seen; and, as they may probably have been growing for ages, the extent of their magnitude is unknown. It is generally supposed that they are the largest inhabitants of the deep; and, were we to credit the Norway Bishop, there are some above a mile over. But to suppose an animal of such a magnitude is absurd; yet the overstretching the supposition does not destroy the probability that animals of this tribe grow to an enormous size.

The ray generally chooses for its retreat such parts of the sea as have a black muddy bottom; the large ones keep at greater depths; but the smaller approach the shores, and feed upon whatever living animals they can surprise, or whatever putrid substances they meet with. As they are ravenous, they easily take the bait, yet will not touch it if it be taken up and kept a day or two out of the water. Almost all fish appear much more delicate with regard to a baited hook than their ordinary food. By their manner they seem to perceive the line, and to dread it; but the impulse of their hunger is too great for their caution; and, though they perceive the danger, if hungry, they devour the destruction.

These fish generate in March and April; at which time only they are seen swimming near the surface of the water, several of the males pursuing one female. The females are prolific to an extreme degree; there having been no less than three hundred eggs taken out of the body of a single ray. In October, when their breeding ceases, they are exceedingly poor and thin; but in November they begin to improve, and grow gradually better till May when they are in the highest perfection.

It is chiefly during the winter season that our fishermen take them; but the Dutch begin their operations earlier, and fish with better success than we. The method practised by the fishermen of Scarborough is thought to be the best among the English; and, as Mr. Pennant has given a very succinct account of it, I will take leave to present it to the reader.

'When they go out to fish, each person is provided with three lines: each man's lines are fairly coiled upon a flat oblong piece of wicker-work; the hooks being baited and placed very regularly in the centre of the coil. Each line is furnished with two hundred and eighty hooks, at the distance of six feet two inches from each other. The hooks are fastened to lines of twisted horse hair, twenty-seven inches in length.

'When fishing, there are always three men in each coble; and consequently nine of these lines are fastened together, and used as one line, extending in length near three miles, and furnished with above two thousand five hundred hooks. An anchor and a buoy are fixed at the first end of the line, and one more at each end of each man's lines: in all, four anchors, and four buoys made of leather or cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast; and, when undisturbed by winds, run each way about six hours. They are so rapid that the fishermen can only shoot and haul their lines at the turn of the tide: and therefore the lines always remain upon the ground about six hours. The same rapidity of tide prevents their using hand-lines; and, therefore, two of the people commonly wrap themselves in the sail and sleep, while the other keeps a strict look-out for fear of being run down by ships, and to observe the weather; for storms often rise so suddenly that it is sometimes with extreme difficulty they escape to the shore, though they leave the lines behind them.

'The coble is twenty-six feet six inches long, and five feet extreme breadth. It is about one ton burden, rowed with three pair of oars, and admirably constructed for the purpose of encountering a mountainous sea. They hoist sail when the wind suits.

'The five-men-boat is forty feet long, fifteen broad, and twenty-five tons burden. It is so called, though navigated by six men and a boy; because one of the men is hired to cook, and does not share in the profits of the other five. All our able fishermen go in these boats to the herring-fishery at Yarmouth, the latter end of September, and return about the middle of November. The boats are then laid up until the beginning of Lent, at which time they go off in them to the edge of the Dogger, and other places, to fish for turbot, cod, ling, and skate, &c. They always take two cobles on board, and when they come upon their ground, anchor the boat, throw out the cobles, and fish in the same manner as those do who go from the shore in a coble; with this difference only, that here each man is provided with double the quantity of lines, and, instead of waiting the return of the tide in the coble, return to the boat, and bait their other lines; thus hauling one set, and shooting another, every turn of tide. They commonly run into the harbour twice a-week, to deliver their fish. The five-men-boat is decked at each end, but open in the middle, and has two long sails.

'The best bait for all kinds of fish, is fresh herring cut in pieces of a proper size; and, notwithstanding what has been said to the contrary, they are taken there at any time in the winter, and all the spring, whenever the fishermen put down their nets for that purpose: the five-men boats always take some nets for that end. Next to herrings are the lesser lampreys, which come all winter by land-carriage from Tadcaster. The next baits in esteem are small haddocks cut in pieces, sand-worms, muscles, and limpets; and, lastly, when none of these can be found, they use bullock's liver. The hooks used there are much smaller than those employed at Iceland and Newfoundland. Experience has shewn that the larger fish will take a living small one upon the hook, sooner than any bait that can be put on; therefore they use such as the fish can swallow. The hooks are two inches and a half long in the shank; and near an inch wide between the shank and the point. The line is made of small cording, and is always tanned before it is used. All the rays and turbots are extremely delicate in their choice of baits: if a piece of herring or haddock has been twelve hours out of the sea, and then used as a bait, they will not touch it.'

Such is the manner of fishing for those fish that usually keep near the bottom on the coasts of England; and Duhamel observes, that the best weather for succeeding, is a half-calm, when the waves are just curled with a silent breeze.

But this extent of line, which runs, as we have seen, three miles along the bottom, is nothing to what the Italians throw out in the Mediterranean. Their fishing is carried on in a tartan, which is a vessel much larger than ours; and they bait a line of no less than twenty miles long, with above ten or twelve thousand hooks. This line is called the *parasina:* and the fishing goes by that of the *pielago*. This line is not regularly drawn every six hours, as with us, but remains for some time in the sea, and it requires the space of twenty-four hours to take it up. By this apparatus they take rays, sharks, and other fish; some of which are above a thousand pounds weight. When they have caught any of this magnitude, they strike them through with a harpoon to bring them on board, and kill them as fast as they can.

This method of catching fish is obviously fatiguing, and dangerous; but the value of the capture generally repays the pain. The skate and the thornback are very good food, and their size, which is from ten pounds to two hundred weight, very well rewards the trouble of fishing for them. It sometimes happens that the lines are visited by unwelcome intruders; by the rough ray, the fireflare, or the torpedo. To all these the fishermen have the utmost antipathy; and, when discovered, shudder at the sight: but they are not always so much upon their guard, but that they sometimes feel the different resentments of this angry tribe; and, instead of a prize, find they have caught an enemy. When such is the case, they throw them back into the sea with expedition.

The rough ray inflicts but slight wounds with the prickles with which its whole body is furnished. To the ignorant it seems harmless, and a man would at first sight venture to take it in his hand, without any apprehension; but he soon finds, that there is not a single part of its body, that is not armed with spines; and that there is no way of seizing the animal, but by the little fin at the end of the tail.

But this animal is harmless, when compared to the fireflare, which seems to be the dread of even the boldest and most experienced fishermen. The weapon with which Nature has armed this animal, which grows from the tail, and which we described as barbed and five inches long, hath been an instrument of terror to the ancient fishermen as well as the modern: and they have delivered many tremendous fables of its astonishing effects.

The torpedo is an animal of this kind, equally formidable and well known with the former; but the manner of its operating is to this hour a mystery to mankind. The body of this fish is almost circular, and thicker than others of the ray kind; the skin is soft, smooth, and of a yellowish colour, marked, as all the kind, with large annular spots; the eyes very small; the tail tapering to a point; and the weight of the fish from a quarter to fifteen pounds. Redi found one twenty-four pounds weight. To all outward appearance, it is furnished with no extraordinary powers; it has no muscles formed for particularly great exertions; no internal conformation perceptibly differing from the rest of its kind; yet such is that unaccountable power it possesses, that, the instant it is touched, it numbs not only the hand and arm, but sometimes also the whole body. The shock received, by all accounts, most resembles the stroke of an electrical machine; sudden, tingling, and painful. 'The instant,' says Kæmpfer, 'I touched it with my hand, I felt a terrible numbness in my arm, and as far up as the shoulder. Even if one treads upon it with the shoe on, it affects not only the leg, but the whole thigh upwards. Those who touch it with the foot, are seized with a stronger palpitation than even those who touched it with the hand. This numbness bears no resemblance to that which we feel when a nerve is a long time pressed, and the foot is said to be asleep; it rather appears like a sudden vapour, which, passing through the pores in an instant, penetrates to the very springs of life, from whence it diffuses itself over the whole body, and gives real pain. The nerves are so affected, that the person struck imagines all the bones of his body, and particularly those of the limb that received the blow, are driven out of joint. All this is accompanied with an universal tremor, a sickness of the stomach, a general convulsion, and a total suspension of the faculties of the mind. In short,' continues Kæmpfer, 'such is the pain, that all the force of our promises and authority could not prevail upon a seaman to undergo the shock a second time. A negro, indeed, that was standing by, readily undertook to touch the torpedo, and was seen to handle it without feeling any of its effects. He informed us, that his whole secret consisted in keeping in his breath; and we found, upon trial, that this method answered with ourselves. When we held in our breath, the torpedo was harmless; but when we breathed ever so little, its efficacy took place.'

Kæmpfer has very well described the effects of this animal's shock; but succeeding experience has abundantly convinced us, that holding in the breath, no way guards against its violence. Those, therefore, who depending on that receipt, should play with a torpedo, would soon find themselves painfully undeceived: not but that this fish may be many times touched with perfect security; for it is not upon every occasion that it exerts its potency. Reaumur, who made several trials upon this animal, has at least convinced the world that it is not necessarily, but by an effort, that the torpedo numbs the hands of him that touches it. He tried several times, and could easily tell when the fish intended the stroke, and when it was about to continue harmless. Always before the fish intended the stroke, it flattened the back, raised the head and the tail, and then, by a violent contraction in the opposite direction, struck with its back against the pressing finger, and the body, which before was flat, became humped and round.

But we must not infer, as he has done, that the whole effect of this animal's exertions arise from the greatness of the blow which the fingers receive at the instant they are struck. We will, with him, allow that the stroke is very powerful, equal to that of a musket-ball, since he will have it so; but it is very well known, that a blow, though never so great on the points of the fingers, diffuses no numbness over the whole body: such a blow might break the ends of the fingers indeed, but would hardly numb the shoulder. Those blows that numb, must be applied immediately to some great and leading nerve, or to a large surface of the body; a powerful stroke applied to the points of the fingers will be excessively painful, but the numbness will not reach beyond the fingers themselves. We must, therefore, look for another cause producing the powerful effects wrought by the torpedo.

Others have ascribed it to a tremulous motion which this animal is found to possess, somewhat resembling that of a horse's skin, when stung by a fly. This operating under the touch with an amazing quickness of vibration, they suppose produces the uneasy sensation described above; something similar to what we feel when we rub plush cloth against the grain. But the cause is quite disproportioned to the effect; and so much beyond our experience, that this solution is as difficult as the wonder we wanted to explain.

The most probable solution seems to be, that the shock proceeds from an animal electricity, which this fish has some hidden power of storing up, and producing on its most urgent occasions. The shocks are entirely similar; the duration of the pain is the same; but how the animal contrives to renew the charge, how it is prevented from evaporating it on contiguous objects, how it is originally procured, these are difficulties that time alone can elucidate.

But to know even the effects is wisdom. Certain it is, that the powers of this animal seem to decline with its vigour; for as its strength ceases, the force of the shock seems to diminish; till, at last, when the fish is dead, the whole power is destroyed, and it may be handled or eaten with perfect security: on the contrary, when immediately taken out of the sea, its force is very great, and not only affects the hand, but if even touched with a stick, the person finds himself sometimes affected. This power is not to be extended to the degree that some would have us believe; as reaching the fishermen at the end of the line, or numbing fishes in the same pond.

To conclude, it is generally supposed that the female torpedo is much more powerful than the male. Lorenzini, who has made several experiments upon this animal, seems convinced that its power wholly resides in two thin muscles that cover a part of the back. These he calls the trembling fibres; and he asserts that the animal may be touched with safety in any other part. It is now known also that there are more fish, than this of the ray kind, possessed of the numbing quality, which has acquired them the name of the torpedo. These are described by Atkins and Moore, and found in great abundance along the coast of Africa.—They are shaped like a mackarel, except that the head is much larger; the effects of these seem also to differ in some respects. Moore talks of keeping his hand upon the animal; which in the ray torpedo it is actually impossible to do. 'There was no man in the company,' says he, 'that could bear to keep his hand on this animal the twentieth part of a minute, it gives him so great pain; but upon taking the hand away, the numbness went off, and all was well again. This numbing quality continued in this torpedo even after it was dead; and the very skin was still possessed of its extraordinary powers till it became dry.' Condamine informs us of a fish possessed of the powers of the torpedo, of a shape very different from the former, and every way resembling a lamprey. This animal, if touched by the hand, or even with a stick, instantly benumbs the hand and arm to the very shoulder; and sometimes the man falls down under the blow. These animals, therefore, must affect the nervous system in a different manner from the former, both with respect to the manner and the intention; but how this effect is wrought, we must be content to dismiss in obscurity.

OF THE LAMPREY AND ITS AFFINITIES.

There is a species of the lamprey served up as a great delicacy among the modern Romans, very different from ours. Whether theirs be the murena of the ancients I will not pretend to say; but there is nothing more certain than that our lamprey is not. The Roman lamprey agrees with the ancient fish in being kept in ponds, and considered by the luxurious as a very great delicacy.

The lamprey, known among us, is differently estimated, according to the season in which it is caught, or the place where it has been fed. Those that leave the sea to deposit their spawn in fresh waters are the best; those that are entirely bred in our rivers, and that have never been at sea, are considered as much inferior to the former. Those that are taken in the months of March, April, or May, just upon their leaving the sea, are reckoned very good; those that are caught after they have cast their spawn, are found to be flabby and of little value. Those caught in several of the rivers in Ireland the people will not venture to touch; those of the English Severn are considered as the most delicate of all other fish whatever.

The lamprey much resembles an eel in its general appearance, but is of a lighter colour, and rather a clumsier make. But it differs in the mouth, which is round, and placed rather obliquely below the end of the nose. It more resembles the mouth of a leech than an eel; and the animal has a hole on the top of the head through which it spouts water, as in the cetaceous kind. There are seven holes on each side for respiration; and the fins are formed rather by a lengthening out of the skin, than any set of bones or spines for that purpose. As the mouth is formed resembling that of a leech, so it has a property resembling that animal of sticking close to and sucking any body it is applied to. It is extraordinary the power they have of adhering to stones, which they do so firmly, as not to be drawn off without difficulty. We are told of one that weighed but three pounds; and yet it stuck so firmly to a stone of twelve pounds that it remained suspended at its mouth, from which it was separated with no small trouble. This amazing power of suction is supposed to arise from the animal's exhausting the air within its body by the hole over the nose, while the mouth is closely fixed to the object, and permits no air to enter. It would be easy to determine the weight this animal is thus able to sustain; which will be equal to the weight of a column of air of equal diameter with the fish's mouth.

From some peculiarity of formation, this animal swims generally with its body as near as possible to the surface; and it might easily be drowned by being kept by force for any time under water. Muralto has given us the anatomy of it; but, in a very minute description, makes no mention of lungs. Yet I am apt to suspect, that two red glands tissued with nerves, which he describes as lying towards the back of the head, are no other than the lungs of this animal. The absolute necessity it is under of breathing in the air, convinces me that it must have lungs, though I do not know of any one that has described them.

The adhesive quality in the lamprey may be in some measure increased by that slimy substance with which its body is all over smeared; a substance that serves at once to keep it warm in its cold element, and also to keep its skin soft and pliant. This mucus is separated by two long lymphatic canals, that extend on each side from the head to the tail, and that furnish it in great abundance. As to its intestines, it seems to have but one great bowel, running from the mouth to the vent, narrow at both ends, and wide in the middle.

So simple a conformation seems to imply an equal simplicity of appetite. In fact, the lamprey's food is either slime and water, or such small water-insects as are scarcely perceptible. Perhaps its appetite may be more active at sea, of which it is properly a native; but when it comes into our rivers, it is hardly seen to devour any thing.

Its usual time of leaving the sea, which it annually does in order to spawn, is about the beginning of spring; and after a stay of a few months it returns again. Their preparation for spawning is peculiar; their manner is to make holes in the gravelly bottom of rivers; and on this occasion their sucking power is particularly serviceable; for if they meet with a stone of a considerable size, they will remove it and throw it out. Their young are produced from eggs in the manner of flat fish; the female remains near the place where they are excluded, and continues with them till they come forth. She is sometimes seen with her whole family playing about her; and after some time she conducts them to the ocean.

But some have not sufficient strength to return; and these continue in the fresh water till they die. Indeed the life of this fish, according to Rondeletius, who has given its history, is but of very short continuance; and a single brood is the extent of the female's fertility. As soon as she has returned, after casting her eggs, she seems exhausted and flabby. She becomes old before her time, and two years is generally the limit of her existence.

However this may be, they are very indifferent eating after they have cast their eggs, and particularly at the approach of hot weather. The best season for them is the months of March, April, and May; and they are usually taken in nets with salmon, and sometimes in baskets at the bottom of the river. It has been an old custom for the city of Gloucester, annually to present the king with a lamprey-pie; and as the gift is made at Christmas, it is not without difficulty the corporation can procure the proper quantity, though they pay a high price for taking them.

THE STURGEON AND ITS VARIETIES.

The sturgeon, with a form as terrible, and a body as large, as the shark, is yet as harmless as the fish we have been just describing; incapable and unwilling to injure others, it flies from the smallest fishes, and generally falls a victim to its own timidity.

The sturgeon in its general form resembles a freshwater pike. The nose is long; the mouth is situated beneath, being small, and without jaw-bones or teeth. But, though so harmless and ill provided for war, the body is formidable to appearance. It is long, pentagonal, and covered with five rows of large, bony knobs, one row on the back and two on each side, and a number of fins to give it greater expedition. Of this fish there are three kinds; the common sturgeon, the caviar sturgeon, and the huso or isinglass-fish. The first has eleven knobs or scales on the back; the second has fifteen; and the latter thirteen on the back, and forty-three on the tail. These differences seem slight to us who only consider the animal's form; but those who consider its uses find the distinction considerable. The first is the sturgeon, the flesh of which is sent pickled into all parts of Europe. The second is the fish from the roe of which that noted delicacy called caviar is made; and the third, besides supplying the caviar, furnishes also the valuable commodity of isinglass. They all grow to a very great size; and some of them have been found above eighteen feet long.

There is not a country in Europe but what this fish visits at different seasons; it annually ascends the largest rivers to spawn, and propagates in an amazing number. The inhabitants along the banks of the Po, the Danube, and the Wolga, make great profit yearly of its incursions up the stream, and have their nets prepared for its reception. The sturgeon also is brought daily to the markets of Rome and Venice, and they are known to abound in the Mediterranean sea. Yet those fish that keep entirely either in salt or fresh water are but comparatively small. When the sturgeon enjoys the vicissitude of fresh and salt water, it is then that it grows to an enormous size, so as almost to rival even the whale in magnitude.

Nor are we without frequent visits from this much esteemed fish in England. It is often accidentally taken in our rivers in salmon nets, and particularly in those parts that are not far remote from the sea. The largest we have heard of, caught in Great Britain, was a fish taken in the Eske, where they are most frequently found, which weighed four hundred and sixty pounds. An enormous size to those who have only seen our freshwater fishes!

North America also furnishes the sturgeon; their rivers in May, June, and July, supply them in great abundance. At that time they sport in the water, and leap from its surface several yards into the air. When they fall again on their sides, the concussion is so violent, that the noise is heard in still weather at some miles distance.

But of all places where this animal is to be found, it appears no where in such numbers as in the lakes of Frischechaff and Curischaff, near Pillau. In the rivers that empty themselves into the Euxine sea, this fish is caught in great numbers, particularly at the mouth of the river Don. In all these places the fishermen regularly expect their arrival from the sea, and have their nets and salt ready prepared for their reception.

As the sturgeon is a harmless fish and no way voracious, it is never caught by a bait in the ordinary manner of fishing, but always in nets. From the description given above of its mouth, it is not to be supposed that the sturgeon would swallow any hook capable of holding so large a bulk and so strong a swimmer. In fact, it never attempts to seize any of the finny tribe, but lives by routing at the bottom of the sea, where it makes insects and sea-plants its whole subsistence. From this quality of floundering at the bottom it has received its name; which comes from the German verb *stoeren*, signifying, to wallow in the mud. That it lives upon no large animals is obvious to those who cut it open, nothing being found in its stomach but a kind of slimy substance, which has induced some to think it lives only upon water and air. From hence there is a German proverb, which is applied to a man extremely temperate, when they say, he is as moderate as a sturgeon.

As the sturgeon is so temperate in its appetites, so is it equally timid in its nature. There would be scarcely any method of taking it, did not its natural desire of propagation induce it to incur so great a variety of dangers. The smallest fish is alone sufficient to terrify a shoal of sturgeons; for, being unfurnished with any weapon of defence, they are obliged to trust to their swiftness and their caution for security. Like all animals that do not make war upon others, sturgeons live in society among themselves; rather for the purposes of pleasure than from any power of mutual protection. Gesner even asserts, that they are delighted with sounds of various kinds; and that he has seen them shoal together at the notes of a trumpet.

The usual time, as was said before, for the sturgeon to come up rivers to deposit its spawn, is about the beginning of summer, when the fishermen of all great rivers make a regular preparation for its reception. At Pillau, particularly, the shores are formed into districts, and allotted to companies of fishermen, some of which are rented for about three hundred pounds a-year. The nets in which the sturgeon is caught, are made of small cord, and placed across the mouth of the river; but in such a manner that, whether the tide ebbs or flows, the pouch of the net goes with the stream. The sturgeon thus caught, while in the water, is one of the strongest fishes that swims, and often breaks the net to pieces that encloses it; but the instant its head is above water, all its activity ceases; it is then a lifeless, spiritless lump, and suffers itself to be dragged on shore. But it has been found prudent to draw it to shore gently; for, if excited by any violence, it has been found to break the fishermen's legs with a blow of its tail. The most experienced fishers, therefore, when they have drawn it to the brink, keep the head elevated, which prevents its doing any mischief with the hinder part of the body: others, by a noose, fasten the head and the tail together; and thus, without immediately dispatching it, bring it to the market, if there be one near, or keep it till their number is completed for exportation.

The flesh, pickled, is very well known at all the tables of Europe; and is even more prized in England than in any of the countries where it is usually caught. The fishermen have two methods of preparing it. The one is by cutting it in long pieces lengthwise, and, having salted them, by hanging them up in the sun to dry: the fish thus prepared is sold in all the countries of the Levant, and supplies the want of better provision. The other method, practised in Holland, and along the shores of the Baltic, is to cut the sturgeon crosswise, into short pieces, and put it into small barrels, with a pickle made of salt and saumure. This is the sturgeon which is sold in England; and of which great quantities came from the North, until we gave encouragement to the importation of it from North America. Thence we are very well supplied; but not with such good fish as comes from the North of Europe.

A very great trade is also carried on with the roe of the sturgeon, preserved in a particular manner, and called caviar: it is made from the roe of all kinds of sturgeon, but particularly the second. This is much more in request in other countries of Europe than with us. To all these high-relished meats, the appetite must be formed by degrees; and though formerly even in England it was very much in request at the politest tables, it is at present sunk entirely into disuse. It is still, however, a considerable merchandize among the Turks, Greeks, and Venetians. Caviar somewhat resembles soft soap in consistence; but it is of a brown, uniform colour, and is eaten as cheese with bread. The manner of making it is this: they take the spawn from the body of the sturgeon—for it is to be observed that the sturgeon differs from other cartilaginous fish, in that it has spawn like a cod, and not eggs like a ray. They take the spawn, I say, and freeing it from the small membranes that connect it together, they wash it with vinegar, and afterwards spread it to dry upon a table; they then put it into a vessel with salt, breaking the spawn with their hands, and not with a pestle; this done, they put it into a canvas bag, letting the liquor drain from it; lastly, they put it into a tub, with holes in the bottom, so that, if there be any moisture still remaining, it may run out; then it is pressed down, and covered up close for use.

But the huso or isinglass fish furnishes a still more valuable commodity. This fish is caught in great quantities in the Danube, from October to January: it is seldom under fifty pounds weight, and often above four hundred: its flesh is soft, glutinous, and flabby; but salted, it is better tasted, and then it turns red like salmon. It is for the commodity it furnishes that it is chiefly taken. Isinglass is of a whitish substance, inclining to yellow, done up into rolls, and so exported for use. It is well known as serviceable, not only in medicine, but many arts. The varnisher, the wine-merchant, and even the clothier know its uses; and great sums are yearly expended upon this single article of commerce. The manner of making it is this; they take the skin, the entrails, the fins, and the tail of this fish, and cut them into small pieces; these are left to macerate in a sufficient quantity of warm water, and they are all boiled shortly after with a slow fire, until they are dissolved and reduced to a jelly; this jelly is spread upon instruments made for the purpose, and drying it, it assumes the form of parchment, and when quite dry, it is then rolled in the form which we see it in the shops.

This commodity is principally furnished from Russia, where they prepare great quantities surprisingly cheap. Mr. Jackson, an ingenious countryman of our own, found out an obvious method of making a glue at home that answered all the purposes of isinglass; but what with the trouble of making it, and perhaps the arts put in practice to undersel him, he was, as I am told, obliged to discontinue the improvement of his discovery. Indeed, it is a vain attempt to manufacture among ourselves those things which may be more naturally and cheaply supplied elsewhere. We have many trades that are unnaturally, if I may so express it, employed among us; who furnish more laboriously those necessaries with which other countries could easily and cheaply supply us. It would be wiser to take what they can thus produce; and to turn our artizans to the increase and manufacture of such productions as thrive more readily among us.

OF ANOMALOUS CARTILAGINOUS FISHES.

Of all others, the cartilaginous class seems to abound with the greatest variety of ill-formed animals; and, if philosophy could allow the expression, we might say, that the cartilaginous class was the class of monsters: in fact, it exhibits a variety of shapeless beings, the deviations of which from the usual form of fishes are beyond the power of words to describe, and scarcely of the pencil to draw. In this class we have the pipe-fish, that almost tapers to a thread, and the sun fish, that has the appearance of a bulky head, but the body cut off in the middle; the hippocampus, with a head somewhat like that of a horse, and the water bat, whose head can scarcely be distinguished from the body. In this class we find the fishing frog, which from its deformity some have called the sea devil, the chimæra, the lump fish, the sea porcupine, and the sea snail. Of all these the history is but little known; and naturalists supply the place with description.

The sun fish sometimes grows to a large size; one taken near Plymouth was five hundred weight. In form it resembles a bream, or some deep fish cut off in the middle: the mouth is very small, and contains in each jaw two broad teeth, with sharp edges: the colour of the back is dusky and dappled, and the belly of a silvery white. When boiled, it has been observed to turn to a glutinous jelly, and would most probably serve for all the purposes of isinglass, were it found in sufficient plenty.

The fishing frog in shape resembles a tadpole or young frog, but then a tadpole of enormous size, for it grows to above five feet long, and its mouth is sometimes a yard wide. Nothing can exceed its deformity. The head is much bigger than the whole body; the under jaw projects beyond the upper, and both are armed with rows of slender, sharp teeth: the palate and the tongue are furnished with teeth in like manner; the eyes are placed on the top of the head, and encompassed with prickles; immediately above the nose, are two long beards or filaments, small in the beginning, but thicker at the end, and round: these, as it is said, answer a very singular purpose; for being made somewhat resembling a fishing-line, it is asserted, that the animal converts them to the purposes of fishing. With these extended, as Pliny asserts, the fishing frog hides in muddy waters, and leaves nothing but the beards to be seen; the curiosity of the smaller fish brings them to view these filaments, and their hunger induces them to seize the bait; upon which the animal in ambush instantly draws in its filaments, with the little fish that had taken the bait, and devours it. This story, though apparently improbable, has found credit among some of our best naturalists; but what induces me to doubt the fact is, that there is another species of this animal that has no beards, which it would not want if they were necessary to the existence of the kind. Rondeletius informs us, that if we take out the bowels, the body will appear with a kind of transparence; and that if a lighted candle be placed within the body, as in a lantern, the whole has a very formidable appearance. The fishermen have in general a great regard for this ugly fish, as it is an enemy to the dog fish, the bodies of those fierce and voracious animals being often found in its stomach; so when they take it they set it at liberty.

The lump fish is trifling in size, compared to the former: its length is but sixteen inches, and its weight about four pounds; the shape of the body is like that of a bream, deep, and it swims edgeways; the back is sharp and elevated, and the belly flat; the lips, mouth, and tongue of this animal are of a deep red; the whole skin is rough, with bony knobs; the largest row is along the ridge of the back; the belly is of a bright crimson colour; but what makes the chief singularity in this fish, is an oval aperture in the belly, surrounded with a fleshy soft substance, that seems bearded all round; by means of this part it adheres strongly to any thing it pleases. If flung into a pail of water, it will stick so close to the bottom, that on taking the fish by the tail, one may lift up pail and all, though it holds several gallons of water. Great numbers are found along the coasts of Greenland in the beginning of summer, where they resort to spawn. The roe is large, and the Greenlanders boil it to a pulp for eating. They are fat, but not admired in England, being flabby and insipid.

The sea snail takes its name from the soft and unctuous texture of its body, resembling the snail upon land. It is almost transparent, and soon dissolves and melts away. It is but a little animal, being not above five inches long. The colour, when fresh taken, is of a pale brown, the shape of the body round, and the back fin reaches all the way from the head to the tail. Beneath the throat is a round depression, of a whitish colour, surrounded by twelve brown spots, placed in a circle. It is taken in England at the mouths of rivers, four or five miles distant from the sea.

The body of the pipe fish, in the thickest part, is not thicker than a swan-quill, while it is above sixteen inches long. This is angular, but the angles being not very sharp, they are not discernible until the fish is dried. Its general colour is an olive brown, marked with numbers of bluish lines, pointing from the back to the belly. It is viviparous; for on crushing one that was just taken, hundreds of very minute young ones were observed to crawl about.

The Hippocampus, which, from the form of its head, some call the sea horse, never exceeds nine inches in length. It is about as thick as a man's thumb, and the body is said, while alive, to have hair on the fore part, which falls off when it is dead. The snout is a sort of tube with a hole at the bottom, to which there is a cover, that the animal can open and shut at pleasure. Behind the eyes are two fins which look like ears; and above them two holes which serve for respiration. The whole body seems to be composed of cartilaginous rings, on the intermediate membranes of which several small prickles are placed. It is found in the Mediterranean, and in the Western Ocean; it more resembles a great caterpillar than a fish. The ancients considered it as venomous; probably induced by its figure.

From these harmless animals, covered with a slight coat of mail, we may proceed to others, more thickly defended, and more formidably armed, whose exact station in the scale of fishes is not yet ascertained. While Linnæus ranks them among the cartilaginous kinds, a later naturalist places them among the spinous class. With which tribe they most agree, succeeding observations must determine. At present we seem better acquainted with their figure than their history: their deformity is obvious; and the venomous nature of the greatest number has been confirmed by fatal experience. This circumstance, as well as the happy distance at which they are placed from us, being all found in the Oriental or American seas, may have prevented a more critical inquiry; so that we know but little of the nature of their malignity, and still less of their pursuits and enmities in the deep.

In the first of this tribe we may place the sea orb, which is almost round, has a mouth like a frog, and is from seven inches to two feet long. Like the porcupine, from whence it sometimes takes its name, being also called the sea porcupine, it is covered over with long thorns or prickles, which point on every side; and, when the animal is enraged, it can blow up its body as round as a bladder. Of this extraordinary creature there are many kinds: some threatening only with spines, as the sea hedgehog; others defended with a bony helmet that covers the head, as the ostracion; others with a coat of mail from the head to the tail, where it terminates in a point, as the centriscus; and others still armed offensively and defensively with bones and spines, as the shield orb.

Of these scarcely one is without its peculiar weapon of offence. The centriscus wounds with its spine; the ostracion poisons with its venom; the orb is impregnable, and absolutely poisons if eaten. Indeed, their figure is not such as would tempt one to make the experiment; and the natives of those countries where they are found, are careful to inform foreigners of their danger: yet a certain sailor at the Cape of Good Hope, not believing what the Dutch told him concerning their venom, was resolved to make the experiment, and break through a prejudice, which, he supposed, was founded on the animal's deformity. He tried, and ate one; but his rashness cost him his life; he instantly fell sick, and died a few days after.

These frightful animals are of different sizes; some not bigger than a foot-ball, and others as large as a bushel. They almost all flatten and erect their spines at pleasure, and increase the terrors of their appearance in proportion to the approach of danger. At first they seem more inoffensive; their body oblong, with all their weapons pointing towards the tail; but, upon being provoked or alarmed, the body that before seemed small, swells to the view; the animal visibly grows rounder and larger, and all its prickles stand upright, and threaten the invader on every side. The Americans often amuse themselves with the barren pleasure of catching these frightful creatures by a line and hook, baited with a piece of sea-crab. The animal approaches the bait with its spines flattened; but when hooked and stopped by the line, all its spines are erected; the whole body being armed in such a manner at all points, that it is impossible to lay hold of it on any part. For this reason it is dragged to some distance from the water, and there it quickly expires. In the middle of the belly of all these there is a sort of bag or bladder filled with air, and by the inflation of which the animal swells itself in the manner already mentioned.

In describing the deformed animals of this class, one is sometimes at a loss whether it be a fish or an insect that lies before him. Thus the hippocampus and the pipe-fish bear a strong resemblance to the caterpillar and the worm; while the lesser orb bear some likeness to the class of sea-eggs to be described after. I will conclude this account of cartilaginous fishes with the description of an animal which I would scarcely call a fish, but that Father Labat dignifies it with the name. Indeed, this class teems with such a number of odd-shaped animals, that one is prompted to rank every thing extraordinary of the finny species among the number; but besides, Labat says, its bones are cartilaginous, and that may entitle it to a place here.

The animal I mean is the galley fish, which Linnæus degrades into the insect tribe, under the title of *the medusa,* but which I choose to place in this tribe, from its habits that are somewhat similar. To the eye of an unmindful spectator, this fish seems a transparent bubble swimming on the surface of the sea, or like a bladder variously and beautifully painted with vivid colours, where red and violet predominate, as variously opposed to the beams of the sun. It is, however, an actual fish; the body of which is composed of cartilages, and a very thin skin filled with air, which thus keeps the animal floating on the surface as the waves and the winds happen to drive. Sometimes it is seen thrown on the shore by one wave, and again washed back into the sea by another. Persons who happen to be walking along the shore often tread upon these animals; and the bursting of their body yields a report like that when one treads upon the swim of a fish. It has eight broad feet with which it swims, or which it expands to catch the air as with a sail. It fastens itself to whatever it meets by means of its legs, which have an adhesive quality. Whether they move when on shore, Labat could never perceive, though he did every thing to make them stir; he only saw that it strongly adhered to whatever substances he applied it. It is very common in America, and grows to the size of a goose-egg, or somewhat more. It is perpetually seen floating; and no efforts that are used to hurt it can sink it to the bottom. All that appears above water is a bladder clear and transparent as glass, and shining with the most beautiful colours of the rainbow. Beneath, in the water, are four of the feet already mentioned that serve as oars, while the other four are expanded above to sail with. But what is most remarkable in this extraordinary creature, is the violent pungency of the slimy substance with which its legs are smeared. If the smallest quantity touch the skin, so caustic is its quality, that it burns it like hot oil dropped on the part affected. The pain is worst in the heat of the day, but ceases in the cool of the evening. From feeding on these he thinks the poisonous quality contracted by some West Indian fish may be accounted for. It is certain these animals are common along all the coasts in the Gulf of Mexico; and when the shore is covered with them in an unusual manner, it is considered as a forerunner of a storm.

THE DIVISION OF SPINOUS FISHES.

THE third general division of fishes is into that of the spinous or bony kind. These are obviously distinguished from the rest by having a complete bony covering to their gills; by being furnished with no other method of breathing but gills only; by bones which are sharp and thorny; and their tails, which are placed in a situation perpendicular to the body. This is that class which alone our later naturalists are willing to admit as fishes. The cetaceous class with them are but beasts that have taken up their abode in the ocean; the cartilaginous class are an amphibious band, that are but half denizens of that element: it is fishes of the spinous kind that deserve the appellation.

This distinction the generality of mankind will hardly allow; but whatever be the justice of this preference in favour of the spinous class, it is certain that the cetaceous and cartilaginous classes bear no proportion to them in number. Of the spinous classes are already known above four hundred species: so that the numbers of the former are trifling in comparison, and make not above a fifth part of the finny creation.

From the great variety in this class, it is obvious how difficult a task it must have been to describe or remember even a part of what it contains. When six hundred different sorts of animals offer themselves to consideration, the mind is bewildered in the multiplicity of objects that all lay some claim to its attention. To obviate this confusion, systems have been devised, which, throwing several fishes that agree in many particulars into one groupe, and thus uniting all into so many particular bodies, the mind that was incapable of separately considering each, is enabled to comprehend all when thus offered in larger masses to its consideration.

Indeed, of all the beings in animated nature, fishes most demand a systematical arrangement. Quadrupeds are but few, and can be all known; birds, from their seldom varying in their size, can be tolerably distinguished without system; but among fishes, which no size can discriminate, where the animal ten inches, and the animal ten feet long is entirely the same, there must be some other criterion by which they are to be distinguished; something that gives precision to our ideas of the animal whose history we desire to know.

Of the real history of fishes, very little is yet known; but of very many we have full and sufficient accounts, as to their external form. It would be unpardonable, therefore, in a history of these animals, not to give the little we do know; and, at least arrange our forces, though we cannot tell their destination. In this art of arrangement, Artedi and Linnæus have long been conspicuous: they have both taken a view of the animal's form in different lights; and, from the parts which most struck them, have founded their respective systems.

Artedi, who was foremost, perceiving that some fishes had hard, prickly fins, as the pike; that others had soft, pliant ones, as the herring; and that others still wanted that particular fin, by which the gills are opened and shut, as the eel, made out a system from these varieties. Linnæus, on the other hand, rejecting this system, which he found liable to too many exceptions, considered the fins, not with regard to their substance, but their position. The ventral fins seem to be the great object of his system; he considers them in fishes supplying the same offices as feet in quadrupeds; and from their total absence, or from their being situated nearer the head or the tail, in different fishes, he takes the differences of his system.

These arrangements, which are totally arbitrary, and which are rather a method than a science, are always fluctuating; and the last is generally preferred to that which went before. There has lately appeared, however, a system composed by Mr. Gouan of Montpelier, that deserves applause for more than its novelty. It appears to me the best arrangement of this kind that ever was made; and in it the divisions are not only precisely systematical, but, in some measure, adopted by Nature itself. This learned Frenchmen has united the systems of Artedi and Linnæus together; and, by bringing one to correct the other, has made out a number of tribes, that are marked with the utmost precision. But a part of his system we have already gone through, in the cartilaginous, or, as he calls a part of them, the *branchiostegous* tribe of fishes. In the arrangement of these, I have followed Linnæus, as the number of them was but small, and his method simple. But in that which is more properly called the *spinous class of fishes*, I will follow Mr. Gouan's system; the terms of which, as well as of all the former systems, require some explanation. I do not love to multiply the technical terms of a science; but it often happens that names, by being long used, are as necessary to be known as the science itself.

If we consider the substance of the fin of a fish, we shall find it composed, besides the skin, either of straight, hard, pointed, bony prickles or spines, as in the pike; or of soft, crooked, or forked bones, or cartilages, as in the herring. The fish that have bony, prickly fins, are called *prickly finned fish;* the latter, that have soft or cartilaginous fins, are called *soft-finned fish.* The prickly-finned fish have received the Greek new-formed name of *Acanthopterigii;* the soft-finned fish have likewise their barbarous Greek name of *Malacoptierigii.* Thus far Artedi has supplied Mr. Gouan with names and divisions. All spinous fish are divided into prickly-finned fish, and soft-finned fish.

Again, Linnæus has taught him to remark the situation of the fins: for the ventral or belly fins, which are those particularly to be remarked, are either wholly wanting, as in the eel, and then the fish is called *Apodal* (a Greek word signifying without feet); or the ventral-fins are placed more forward than the pectoral fins, as in the haddock, and then the animal is called a *Jugular-fish;* or the ventral-fins are placed directly under the pectoral-fins, as in the father-lasher, and then it is called a *Thoracic-fish:* or, lastly, the ventral-fins are placed nearer the tail than the pectoral-fins, as in the minnow, and then it is an *Abdominal-fish.*

Possessed of these distributions, the French naturalist mixes and unites them into two grand divisions. All the prickly-finned fish make one general division; all the soft-finned fish another. These first are distinguished from each other, as being either *apodal, jugular, thoracic,* or *abdominal.* Thus there are prickly-finned *apodal* fishes; prickly-finned *jugular* fishes, prickly-finned *thoracic* fishes, and prickly-finned *abdominal* fishes. On the other hand, the soft-finned fishes fall under a similar distribution, and make the other general division. Thus there are soft-finned *apodal* fishes, soft-finned *jugular* fishes, soft-finned *thoracic* fishes, and soft-finned *abdominal* fishes. These general characters are strongly marked, and easily remembered. It only remains, therefore, to divide these into such tribes as are most strongly marked by Nature; and to give the distinct character of each, to form a complete system with great simplicity. This Mr. Gouan has done; and the tribes into which he has distributed each of these divisions, exactly amount to fifty. Thus the reader, who can contain in his memory the characteristic marks of fifty kinds, will have a tolerable idea of the form of every kind of spinous fish. I say, of the form; for as to the history and nature of the animal itself, that can only be obtained by experience and information.

SECT. I.—PRICKLY-FINNED FISHES.

Prickly-finned Apodal Fish.

1. The *Trichurus.* The body of a sword-form; the head oblong; the teeth sword-like, bearded near the points; the fore teeth largest; the fin that covers the gills with seven spines; the tail ending in a point without fins; an inhabitant near the oriental and American shores; of a silvery white; frequently leaping into the fishermen's boats in China.

2. The *Xiphias* or *Sword-fish.* The body round: the head long; the upper-jaw terminating by a long beak, in form of a sword; the fin that covers the gills with six spines; an inhabitant of Europe; an enemy to the whale.

3. The *Ophidium* or *Gilthead.* The body sword-like; the head blunt; the fin covering the gills with seven spines; the opening of the mouth side-ways; the fins of the back, the anus, and the tail all joining together; the most beautiful of all fishes, covered over with green, gold, and silver; it is by sailors called the dolphin, and gives chase to the flying-fish.

Prickly-finned Jugular Fish.

4. The *Trachinus* or *Weaver.* The body oblong; the head obtuse; the bones covering the gills jagged at the bottom; the fins covering the gills with six spines; the anus near the breast; buries itself in the sands, leaving only its nose out; and if trod upon, immediately strikes with the spines that form its dorsal fins, which are venomous and dangerous.

5. The *Uranoscopus.* The body wedge-like: the head almost round, and larger than the body; the mouth flat; the eyes on the top of the head; the fin covering the gills with five spines; the anus in the middle of the body; an inhabitant of the Mediterranean Sea.

6. The *Callyonymus* or *Dragonet.* The body almost wedge-like; the head broad, and larger than the body; the mouth even with the body; the bony covering of the gills close shut; the opening to the gills behind the head; the fin covering the gills with six spines, an inhabitant of the Atlantic Ocean.

7. The *Blennius* or *Blenny.* The body oblong; the head obtusely bevel; the teeth a single range; the fin covering the gills with six spines; the ventral fins have two small blunt bones in each; a species of this animal is viviparous.

Prickly-finned Thoracic Fishes.

8. The *Gobius* or *Gudgeon.* The body round and oblong; the head with two little holes between the eyes, one before the other; the fin covering the gills with six spines; the ventral fins joined together.

9. The *Cepola.* The body sword-like; the head blunt; the mouth flat; the fin covering the gills with six spines; the fins distinct; an inhabitant of the Mediterranean Sea.

10. The *Coryphæna* or *Razor-fish.* The body wedge-like; the head very bevel; the fin covering the gills with five spines.

11. The *Scomber* or *Mackarel.* The body oblong; the line running down the side zigzagged towards the tail; the head sharp and small; the fins covering the gills with six spines; several false fins towards the tail.

12. The *Labrus* or *Wrasse.* The body oval; the

head middling; the lips doubled inward; both cutting and grinding teeth; the covers of the gills scaly; the fin covering the gills with five spines; the pectoral fins pointed.

13. The *Sparus* or *Sea-bream.* The body oblong; the head middling; the lips not inverted; the teeth cutting and grinding; the cover of the gills scaly; the fins covering the gills with five rays; the pectoral fins pointed.

14. The *Chætodon* or *Cat-fish.* The body oblong; the head small; the teeth slender and bending; the fin covering the gills with five or six spines; the fins of the back and anus scaly.

15. The *Sciæna.* The body nearly elliptical; the head bevel, the covers of the fins scaly; the fin covering the gills with six rays; the fins of the back jagged, and hidden in a furrow in the back.

16. The *Perch.* The body oblong; the head bevel; the covers of the gills scaly and toothed; the fin covering the gills with seven spines; the fins in some jagged.

17. The *Scorpæna* or *Father-lasher.* The body oblong; the head great, with beards; the covers of the gills armed with prickles; the fin covering the gills with seven spines.

18. The *Mullus* or *Surmulet.* The body slender; the head almost four-cornered; the fin covering the gills with three spines; some of these have beards; a fish highly prized by the Romans, and still considered as a very great delicacy.

19. The *Trigla* or the *Gurnard.* The body slender; the head nearly four-cornered, and covered with a bony coat, the fin covering the gills with seven spines; the pectoral and ventral fins, strengthened with additional muscles and bones, and very large for the animal's size.

20. The *Cottus* or *Bull-head.* The body wedge-like; the head flat and broader than the body; the fin covering the gills with six spines; the head furnished with prickles, knobs, and beards.

21. The *Zeus* or *Doree.* The body oblong; the head bevel; the fin covering the gills with seven rays; fins jagged, the upper-jaw with a loose floating skin depending into the mouth.

22. The *Thrachipterus* or *Sabre.* The body sword-like; the head bevel; the fin covering the gills with six spines; the lateral line straight; the scales in a single order; a loose skin in both the jaws.

23. The *Gasterosteus* or *Stickleback.* The body broadest towards the tail; the head oblong; the fin covering the gills with three spines; prickles starting backward before the back fins and the fins of the anus.

Prickly-finned Abdominal Fish.

24 The *Silurus* or *Sheath Fish.* The body oblong; the head large; the fin covering the gills from four to fourteen spines; the leading bones or spines in the back and pectoral fins toothed.

25. The *Mugil* or *Mullet.* The body oblong; the head almost conical; the upper jaw with a furrow, which receives the prominence of the under; the fin covering the gills with seven rays.

26. The *Polynemus.* The body oblong; the head with a beak; the fin covering the gills with from five to seven spines; the bones that move the pectoral fins not articulated to those fins.

27. The *Theutys.* The body almost elliptical: the head abruptly shortened: the fin covering the gills with five rays; the teeth in a single row, close, strong, and even.

28. The *Elops* or *Sea-serpent.* The body slender; the head large; the fin covering the gills double with thirty spines, and armed externally with five bones resembling teeth.

SECT. II.—SOFT-FINNED FISHES.

Soft-finned Apodal Fishes.

29. The *Muræna* or *Eel.* The body round and slender; the head terminating in a beak; the fin covering the gills with ten rays; the opening to the gills pipe-fashion, placed near the pectoral fins; the fins of the back, the anus, and the tail, united in one.

30. The *Gymnotus* or *Carapo.* The body broadest on the back, like the blade of a knife; the head small; the fin covering the gills with five rays; the back without a fin; two beards or filaments from the upper lip; an inhabitant of Brasil.

31. The *Anarchias* or *Wolf-fish.* The body roundish and slender; the head large and blunt; the fore teeth above and below conical; the grinding teeth and those in the palate round; the fin covering the gill has six rays.

32 The *Stromateus.* The body oblong; the head small; the teeth moderately sharp; the fin covering the gills with five or six rays.

33. The *Ammodytes* or *Launce.* The body slender and roundish; the head terminated by a beak; the teeth of a hair-like fineness; the fin covering the gills with seven rays.

Soft-finned Jugular Fishes.

34. The *Lepadogaster.* The body wedge-like; the head oblong, forwarder than the body, flattish, the beak resembling that of a duck; the pectoral fins double, two on each side; the ventral fins joined together; a kind of bony breast-plate between the pectoral fins; the fin covering the gills with five rays; the opening to the gills pipe-fashion.

35. The *Gadus* or *Cod Fish.* The body oblong; the

head wedge-like; the fin covering the gills with seven rays; several back and anal fins.

Soft-finned Thoracic Fishes.

36. The *Plemonecles* or *Flumide.* The body elliptical; the head small; both eyes on one side of the head; the fin covering the gills with from four to seven rays.

37. The *Echeneis* or *Sucking-fish.* The body almost wedge-like, moderately round; the head broader than the body: the fin covering the gill with ten rays; an oval breast-plate, streaked in form of a ladder, toothed.

38. The *Lipidopus* or *Garter-fish.* The body sword-like; the head lengthened out; the fins covering the gills with seven rays; three scales only on the whole body; two in the place of the ventral fins; the third from that of the anus.

Soft-finned Abdominal Fishes.

39. The *Loricaria.* The body crusted over; the head broad with a beak; no teeth; the fin covering the gills with six rays.

40. The *Atherina* or *Atherine.* The body oblong; the head of a middling size; the lips indented; the fin covering the gills with six rays; the line on the sides resembling a silver band.

41. The *Salmo* or *Salmon.* The body oblong; the head a little sharp; the fin covering the gills from four to ten rays; the last fin on the back, without its correspondent muscle: fat.

42. The *Fistularia.* The body angular, in form of a spindle; the head pipe-fashion, with a beak; the fin covering the gills with seven rays; the under-jaw covering the upper.

43. The *Esox* or *Pike.* The body round; the head with a beak; the under jaw piercing longitudinally with small holes; the fin covering the gills with from seven to twelve rays.

44. The *Argentina* or *Argentine.* The body a little round and slender: the head with a beak broader than the body; the fin covering the gills with eight rays; a spurious back-fin.

45. The *Clupea* or *Herring.* The body a little oblong; the head with a small beak; the fin covering the gills with eight rays.

46. The *Exocetas* or *Flying-fish.* The body oblong; the head almost three-cornered; the fin covering the gills with ten rays; the pectoral fins placed high, and as long as the whole body; the back-fin at the extremity of the back.

47. The *Cyprinus* or *Carp.* The body elongated, almost round; the head with a small beak; the hinder part of the bone covering the gills, marked with a crescent; the fin covering the gills with three rays.

48. The *Cobitis* or *Loach.* The body oblong; almost equally broad throughout; the head small, a little elongated; the eyes in the hinder part of the head; the fin covering the gills from four to six rays; the covers of the gills closed below.

49. The *Amia* or *Bonito.* The body round and slender; the head, forehead, and breast, without skin; the fin covering the gills with twelve rays; two beards from the nose.

50. The *Mormyrus.* The body oblong; the head elongated; the fin covering the gills with a single ray; the opening to the gills is linear, and has no bone covering them.

Such is the system of Mr. Gouan; by reducing to which any fish that offers, we can know its rank, its affinities, and partly its anatomy, all which make a considerable part in its natural history. But, to show the use of this system still more apparently, suppose I meet with a fish, the name to me unknown, of which I desire to know something more. The way is first to see whether it be a cartilaginous fish, which may be known by its wanting fins to open and shut the gills, which the cartilaginous kinds are wholly without. If I find that it has them, then it is a spinous fish; and in order to know its kind, I examine its fins, whether they be prickly or soft: I find them soft; it is therefore to be ranked among the soft-finned fishes. I then examine its ventral or belly fins, and finding that the fish has them, I look for their situation, and find they lie nearer to the tail than the pectoral fins. By this I find the animal to be a soft-finned abdominal fish. Then to know which of the kinds of these fishes it is, I examine its figure and the shape of its head; I find the body rather oblong; the head with a small beak; the lower jaw like a saw; the fin covering the gills with eight rays. This animal must therefore be the herring, or one of that family, such as the pilchard, the sprat, the shad, or the anchovy. To give another instance: Upon examining the fins of a fish to me unknown, I find them prickly; I then look for the situation of the ventral fins, I find them entirely wanting; this then must be a prickly-finned apodal fish. Of this kind there are but three; and by comparing the fish with the description, I find it either of the trichurus kind, the sword-fish, or the gilt-head. Upon examining also its internal structure, I shall find a very great similitude between my fish and that placed at the head of the family.

OF SPINOUS FISHES IN GENERAL.

Having given a method by which spinous fishes may be distinguished from each other, the history of each in particular might naturally be expected to follow: but such a distinct account of each would be very disgusting from the unavoidable uniformity of every description. The history of any one of this class very much resembles that of all the rest: they breathe air and water through the gills; they live by rapine, each devouring such animals as its mouth is capable of admitting; and they propagate, not by bringing forth their young alive, as in the cetaceous tribes, nor by distinct eggs, as in the generality of the cartilaginous tribes, but by spawn, or peas, as they are generally called, which they produce by hundreds of thousands. These are the leading marks that run through their whole history, and which have greatly swelled books with tiresome repetition.

It will be sufficient, therefore, to draw this numerous class into one point of view, and to mark how they differ from the former classes; and what they possess peculiarly striking, so as to distinguish them from each other. The first object that presents itself, and that by which they differ from all others, are the bones. These when examined but slightly, appear to be entirely solid; yet, when viewed more closely, every bone would be found hollow, and filled with a substance less rancid and oily than marrow. These bones are very numerous, and pointed; and, as in quadrupeds, are props or stays to which the muscles are fixed which move the different parts of the body.

The number of bones in all spinous fishes of the same kind, is always the same. It is a vulgar way of speaking to say, that fishes are at some seasons more bony than at others; but this does not require contradiction. It is true indeed, that fish are at some seasons fatter than at others; so that the quantity of the flesh being diminished, and that of the bones remaining the same, they appear to increase in number, as they bear a greater proportion.

All fish of the same kind, as was said, have the same number of bones: the skeleton of a fish, however irregularly the bones may fall in our way at table, has its members regularly disposed; and every bone has its fixed place, with as much precision as we find in the orders of a regular fabric. But then spinous fish differ in the number of bones according to the species; for some have a greater number of fins by which they move in the water. The number in each is always in proportion to the number and size of these fins: for every fish has a regular apparatus of bones and muscles, by which the fins are moved; and all those fish where they are numerous or large, must, of consequence, be considerably bony. Indeed, in the larger fish, the quantity of flesh is so much, and the bones themselves are so large, that they are easily seen and separated; but in the smaller kinds with many fins, the bones are as numerous as in the great; yet being so very minute, they lurk almost in every part of the flesh, and are dangerous as well as troublesome to be eaten. In a word, those fish which are large, fat, and have few fins, are found to be the least bony; those which are small, lean, and have many fins, are the most bony of all. Thus, for instance, a roach appears more bony than a carp, because it is leaner and smaller; and it is more bony than an eel, because it has a greater number of fins.

As the spinous fish partake less of the quadruped in their formation than any others, so they can bear to live out of their own element a shorter time. In general, when taken out of the water, they testify their change by panting most violently and at closer intervals, the thin air not furnishing their gills the proper play; and in a few minutes they expire. Some are more vivacious in air than others; the eel will live several hours out of water; and the carp has been known to be fattened in a damp cellar. The method is by placing it in a net well wrapped up in wet moss, the mouth only out, and then hung up in a vault. The fish is fed with white bread and milk; and the net now and then plunged into the water. The animal, thus managed, has been known not only to live for a fortnight, but to grow exceedingly fat and of a superior flavour. Hence it would seem that the want of moisture in the gills, is the chief cause of the death of these animals; and could that be supplied, their lives might be prolonged in the air, almost as well as in their own element.

It is not possible to account for the different operations of the same element, upon animals, that, to appearance, have the same conformation. To some fishes, bred in the sea, fresh water is immediate destruction: on the other hand, some fishes, that live in our lakes and ponds, cannot bear the salt water. Whence this difference can arise, is not easily to be accounted for. The saline quality of the water cannot properly be given as the cause; since no fishes imbibe any of the sea's saltness with their food, or in respiration. The flesh of all fishes is equally fresh, both in the river, and in the saltest depths of the ocean; the salt of the element in which they live, no way mixing with their constitution. Whence then is it that animals will live only there, and will quickly expire, when carried into fresh water? It may perhaps arise from the superior weight of the sea-water; as from the great quantity of salt dissolved in its composition, it is heavier than fresh water, so probably it lies with greater force upon the organs of respiration, and gives them their necessary play: on the other hand, those fish which are used only to fresh water, cannot bear the weight of the saline fluid, and expire in a manner suffocated in the grossness of the strange element.

Although there are some tribes that live only in the sea, and others in fresh water, yet there are some whose organs are equally adapted to either element; and that spend a part of their season in one, and a part in the other. Thus the salmon, the shad, the smelt, and the flounder, annually quit their native ocean, and come up our rivers to deposit their spawn. This seems the most important business of their lives; and there is no danger which they will not encounter, even to the surmounting precipices, to find a proper place for the depositing of their future offspring. The salmon, upon these occasions, is seen to ascend rivers five hundred miles from the sea; and to brave not only the danger of various enemies, but also to spring up cataracts as high as a house. As soon as they come to the bottom of the torrent, they seem disappointed to meet the obstruction, and swim some paces back: they then take a view of the danger that lies before them, survey it motionless for some minutes, advance, and again retreat; till at last summoning up all their force, they take a leap from the bottom, their body straight, and strongly in motion; and thus most frequently clear every obstruction. It sometimes happens, however, that they want strength to make the leap; and then, in our fisheries they are taken in their descent. But this is one of the smallest dangers that attend these adventuring animals in their progress: numberless are the methods of taking them; as well by the hook, as by nets, baskets, and other inventions, which it is not our business here to describe. Their capture makes, in several countries, a great article of commerce; and being cured in several different manners, either by salting, pickling, or drying, they are sent to all the markets of Europe.

As these mount up the rivers to deposit their spawn, others, particularly the eel, descend the fresh water stream, as Rhedi assures us, to bring forth their young in the sea. Annually, about August, these animals take the opportunity of the most obscure nights, and when the rivers are flooded by accidental rains, to seek the ocean. When they have reached the sea, and produced their young, for they are viviparous, they again ascend the stream, at different times as opportunity offers, or as the season is favourable or tempestuous. Their passage begins usually about the close of January, and continues till towards the end of May, when they are taken in the river Arno by millions, and so small that a thousand of them goes to a pound. There is nothing more certain than that they descend in our own rivers after floods, in great abundance, and are thus caught in nets, to advantage. They possess also a power of climbing over any obstacle; for, by applying their glutinous and slimy bodies to the surface of the object they desire to surmount, they can thus creep up locks, weirs, and every thing that would prevent their ascending the current of the stream.

But the length of the voyage performed by these fishes, is sport, if compared to what is annually undertaken by some tribes, that constantly reside in the ocean. These are known to take a course of three or four thousand miles in a season, making prey to whales, sharks, and the flocks of water-fowl, that regularly wait to intercept their progress. These may be called fish of passage, and bear a strong analogy to birds of passage, both from their social disposition, and the immensity of their numbers. Of this kind are the cod, haddock, whiting, mackarel, tunny, herring, and pilchard. Other fish live in our vicinity, and reside on our coasts all the year; or keep in the depths of the ocean, and are seldom seen: but these visit their accustomed haunts with regularity, generally returning the same week in the succeeding year, and often the same day.

The stated returns, and the regular progress of these fish of passage, is one of the most extraordinary circumstances in the History of Nature. What it is that impels them to such distant voyages; what directs their passage; what supports them by the way; and what sometimes prompts them to quit, for several seasons, one shore for another, and then return to their accustomed harbour, are questions that curiosity may ask, but philosophy cannot resolve. Satisfied with the certainty of the facts, we must dismiss inquiry.

The cod seems to be the foremost of this wandering tribe, and is only found in our northern part of the world. This animal's chief place of resort is on the banks of Newfoundland, and the other sand-banks that lie off Cape Breton. That extensive flat seems to be no other than the broad top of a sea-mountain, extending for above five hundred miles long, and surrounded with a deeper sea. Hither the cod annually repair in numbers beyond the power of calculation, to feed on the quantity of worms that are to be found there in the sandy bottom. Here they are taken in such quantities, that they supply all Europe with a considerable share of provision. The English have stages erected all along the shore for salting and drying them; and the fishermen, who take them with the hook and line, which is their method, draw them in as fast as they can throw out. But this immense capture makes a very small diminution, when compared to their numbers; and when their provision there is exhausted, or the season for propagation returns, they go off to the polar seas, where they deposit their roes in full security. From thence want of food forces them, as soon as the first more southern seas are open, to repair southward for subsistence. Nor is this fish an unfrequent visitant upon our own shores: but the returns are not so regular, nor does the capture bear any proportion to that at Newfoundland.

The haddock, the whiting, and the mackarel, are thought by some to be driven upon our coasts rather by their fears than their appetites; and it is to the pursuit of the larger fishes, we owe their welcome visits. It is much more probable, that they come for that food which is found in more plenty near the shore than farther out at sea. One thing is remarkable, that their migrations seem to be regularly conducted. The grand shoal of haddocks that comes periodically on the Yorkshire coasts, appeared there in a body on the tenth of December, 1766; and exactly on the same day in the following year. This shoal extended from the shore near three miles in breadth, and in length for more than forty. The limits of a shoal are precisely known; for if the fishermen put down their lines at the distance of more than three miles from shore, they catch nothing but dog-fish; a proof that the haddock is not there.

But of all migrating fish, the herring and the pilchard take the most adventurous voyages. Herrings are found in the greatest abundance in the highest northern latitudes. In those inaccessible seas, that are covered with ice for a great part of the year, the herring and pilchard find a quiet and sure retreat from all their numerous enemies; thither neither man, nor their still more destructive enemy, the fin-fish, or the cachalot, dares to pursue them. The quantity of insect food which those seas supply, is very great; whence, in that remote situation, defended by the icy rigour of the climate, they live at ease, and multiply beyond expression. From this most desirable retreat, Anderson supposes, they would never depart, but that their numbers render it necessary for them to migrate; and as with bees from a hive, they are compelled to seek for other situations.

For this reason, the great colony is seen to set out from the icy sea about the middle of winter; composed of numbers, that if all the men in the world were to be loaded with herrings, they would not carry the thousandth part away. But they no sooner leave their retreats, but millions of enemies appear to thin their squadrons. The fin-fish and cachalot swallow barrels at a yawn; the porpesse, the grampus, the shark, and the whole numerous tribe of dog-fish, find them an easy prey, and desist from making war upon each other: but, still more, the unnumbered flocks of sea-fowl, that chiefly inhabit near the pole, watch the outset of their dangerous migration, and spread extensive ruin.

In this exigence the defenceless emigrants find no other safety but by crowding closer together, and leaving to the outmost bands the danger of being the first devoured: thus, like sheep when frighted, that always run together in a body, and each finding some protection in being but one of many that are equally liable to invasion, they are seen to separate into shoals, one body of which moves to the west, and pours down along the coasts of America, as far south as Carolina, and but seldom farther. In Chesapeak Bay, the annual inundation of these fish is so great, that they cover the shores in such quantities as to become a nuisance. Those that hold more to the east, and come down towards Europe, endeavour to save themselves from their merciless pursuers, by approaching the first shore they can find; and that which first offers in their descent, is the coast of Iceland, in the beginning of March. Upon their arrival on that coast, their phalanx, which has already suffered considerable diminutions, is, nevertheless, of amazing extent, depth, and closeness, covering an extent of shore as large as the island itself. The whole water seems alive; and is seen so black with them to a great distance, that the number seems inexhaustible. There the porpesse and the shark continue their depredations; and the birds devour what quantities they please. By these enemies the herrings are cooped up into so close a body, that a shovel, or any hollow vessel put into the water, takes them up without farther trouble.

That body which comes upon our coasts, begins to appear off the Shetland Isles in April. These are the forerunners of the grand shoal which descends in June; while its arrival is easily announced, by the number of its greedy attendants, the gannet, the gull, the shark, and the porpesse. When the main body is arrived, its breadth and depth is such as to alter the very appearance of the ocean. It is divided into distinct columns, of five or six miles in length, and three or four broad; while the water before them curls up, as if forced out of its bed. Sometimes they sink for the space of ten or fifteen minutes, then rise again to the surface; and, in bright weather, reflect a variety of splendid colours, like a field bespangled with purple, gold, and azure. The fishermen are ready prepared to receive them; and, by nets made for the occasion, they take sometimes above two thousand barrels at a single draught.

From the Shetland Isles, another body of this great army, where it divides, goes off to the western coasts of Ireland, where they meet with a second necessity of dividing. The one takes to the Atlantic, where it is soon lost in that extentive ocean; the other passes into the Irish sea, and furnishes a very considerable capture to the natives.

The herrings thus expelled from their native seas, seek those bays and shores where they can find food, and the best defence against their unmerciful pursuers of the deep. In general, the most inhabited shores are the places where the larger animals of the deep are least fond of pursuing; and these are chosen by the herring as an asylum from greater dangers. Thus, along the coasts of Norway, the German shores, and the northern shores of France, these animals are found punctual in their visitations. In these different places they produce their young, which, when come to some degree of maturity, attend the general motions. After the destruction of such numbers, the quantity that attempts to return is but small; and Anderson doubts whether they ever return.

Such is the account given of the migration of these fishes, by one who, of all others, was best acquainted with their history; and yet many doubts arise in every part of the migration. The most obvious which has been made is, that though such numbers perish in their descent from the north, yet, in comparison to those that survive, the account is trifling: and it is supposed, that of those taken by man, the proportion is not one to a million. Their regularly leaving the shore also at a stated time, would imply that they are not in their visits under the impulse of necessity. In fact, there seems one circumstance that shows these animals governed by a choice with respect to the shores they pitch upon; and not blindly drove from one shore to another. What I mean is, their fixing upon some shores for several seasons, or indeed, for several ages together; and, after having regularly visited them every year, then capriciously forsaking them, never more to return. The first great bank for herrings was along the shores of Norway. Before the year 1584, the number of ships from all parts of Europe that resorted to that shore, exceeded some thousands. But soon after that period, these animals were seen to desert the Norway shores, and frequent the German coast, where the Hanse-Towns drove a great trade by their capture and sale; but, for above a century, the herrings have, in a great measure, forsaken them; and their greatest colonies are seen in the British Channel, and upon the Irish shores. It is not easy to assign a cause for this seemingly capricious desertion: whether the number of their finny enemies increasing along the northern coasts, may have terrified the herring tribe from their former places of resort; or, whether the quantity of food being greater in the British Channel, may not allure them thither, is not easy to determine.

The pilchard, which is a fish differing little from the herring, makes the coast of Cornwall its place of principal resort. Their arrival on that coast is soon proclaimed by their attendants the birds, and the larger fishes; and the whole country prepare to take the advantage of this treasure, providentially thrown before them. The natives sometimes inclose a bay of several miles extent with their nets called *saines*. To direct them in their operations, there were some years ago (but I believe they are discontinued) several men placed on eminences near the shore, called *huers*, who, with brooms in their hands, gave signals where the nets were to be extended, and where the shoals of fishes lay: this they perceived by the colour of the water, which assumed a tincture from the shoals beneath. By these means, they sometimes take twelve or fifteen hundred barrels of pilchards at a draught; and place them in heaps on the shore. It often happens, that the quantity caught exceeds the salt or the utensils for curing them; and then they are carried off to serve for the purposes of manure. This fishery employs not only great numbers of men at sea, training them to naval affairs, but also numbers of women and children on land, in salting and curing the fish; in making boats, nets, ropes, and casks, for the purposes of taking or fitting them for sale. The poor are fed with the superfluity of the capture; the land is manured with the offals: the merchant finds the gain of commission, and honest commerce; the fisherman a comfortable subsistence from his toil.—"Ships," says Dr. Borlase, "are often freighted hither with salt, and into foreign countries with the fish, carrying off at the same time a part of our tin. The usual produce of the number of hogsheads exported for ten years, from 1747 to 1756 inclusive, amounted to nearly thirty thousand hogsheads each year; every hogshead has amounted, upon an average, to the price of one pound thirteen shillings and three-pence. Thus the money paid for pilchards exported, has annually amounted to near fifty thousand pounds." This, according to our present value of money, would be a large sum.

Whence these infinite numbers are derived, still remains obscure; but it will increase our wonder to be told, that so small a fish as the stickleback, which is seldom above two inches long, and that one would think could easily find support in any water, is yet obliged to colonize, and leave its native fens in search of new habitations. Once every seventh or eighth year, amazing shoals of these appear in the river Welland, near Spalding, and come up the stream, forming one great column. They are supposed to be multitudes collected in some of the fens, till overcharged with numbers, they are periodically obliged to migrate. An idea may be had of their numbers, when we are informed, that a man, employed by a farmer to take them, for the purpose of manuring his grounds, has got, for a considerable time, four shillings a-day, by selling them at a halfpenny a bushel!

Thus we see the amazing propagation of fishes along our own coasts and rivers; but their numbers bear no proportion to the vast quantities found among the islands of the Indian ocean. The inhabitants of these countries are not under the necessity even of providing instruments for fishing; it is but going down to the shore, and there the fish are found in great numbers in the plashes that still continue to have water in them. In some of these places the quantity is so great, that they are left in shoals, on those swamps, dried up by the sun, and their putrefaction contributes to render the country unhealthful.

This power of increasing in these animals, exceeds our idea, as it would, in a very short time, outstrip all calculation. A single herring if suffered to multiply unmolested and undiminished for twenty years, would show a progeny greater in bulk than ten such globes as that we live upon. But happily the balance of Nature is exactly preserved; and their consumption is equal to their fecundity. For this reason we must consider the porpesse, the shark, or the cod-fish, not in the light of plunderers and rivals, but of benefactors to mankind. Without their assistance, the sea would soon become overcharged with the burden of its own productions; and that element, which at present distributes health and plenty to the shore, would but load it with putrefaction.

In the propagation of all fish, some degree of warmth seems necessary, not only to their preservation, but the advancement of their posterity. Their spawn is always deposited in those places where the sun-beams may reach them, either at the bottom of shallow shores or floating on the surface in deeper waters. A small degree of heat answers all the purposes of incubation, and the animal issues from the egg in its state of perfect formation, never to undergo any succeeding change.

Yet, still I have some doubts whether most fish come from the egg completely formed. We know that in all the frog tribe, and many of the lizard kind, they are produced from the egg in an imperfect form. The tadpole, or young frog, with its enormous head and slender tail, are well known; a species of the lizard also, which is excluded from the shell without legs, only acquires them by degrees, and not till after some time does it put off its serpent form. Probably some kinds of fish in like manner suffer a change; and though it be too inconsiderable to strike the fisherman or the inattentive spectator, yet it makes a very material difference to the naturalist, and would disarrange his most favourite systems. A slight alteration in the fins or bones that cover the gills would overturn the whole fabric of the most applauded icthyologist; and yet, as I observed, it is likely that these alterations often take place.

As a proof of this, during the month of July, there appear near Greenwich innumerable shoals of small fishes, which are known to the Londoners by the name of white bait. It is universally agreed that they are the young of some fish; they are never seen but at this time of the year, and never found to have any roe, a circumstance that proves their not being come to maturity. The quantity is amazing; and the fish that produces them in such numbers must be in plenty, though it is not yet known what that fish is, as they correspond with no other species whatever. They most resemble the smelt in form; and yet they want a fin, which that animal is never without. They cannot be the bleak, as they are never found in other rivers where the bleak breeds in great abundance. It is most probable, therefore, that they are the young of some animal not yet come to their perfect form, and therefore reducible to no present system.

The time that spinous fishes continue in the pea is in proportion to the size of the kind. It is a rule that chiefly holds through Nature, that the larger the animals are, the longer they continue before exclusion. This I say holds generally through all Nature, though it is not easy to assign a cause for so well known a truth. Perhaps, as all large bodies take a longer time to grow hot than small ones, so the larger the egg, the longer influence of vital warmth it requires to reach through all its recesses, and to unfold the dormant springs that wait to be put into motion.

Although the usual way with spinous fishes is to produce by spawn; yet there are some, such as the eel and the blenny, that are known to bring forth their young alive. Bowlker, who has written a treatise upon fishing, seems to determine the question relative to the viviparous production of eels, upon the authority of one or two credible witnesses. An eel, opened in the presence of several persons of credit, was found to have an infinite number of little creatures, closely wrapped up together in a lump, about the size of a nutmeg, which being put into a basin of water, soon separated, and swam about: yet still, whether these may not have been worms generated in the animal's body, remains a doubt; for there are scarcely any fishes that are not infested with worms in that manner.

With respect to the growth of fishes, it is observed, that among carps, particularly the first year, they grow to about the size of the leaf of a willow-tree; at two years, they are about four inches long. They grow but one inch more the third season, which is five inches. Those of four years old are about six inches; and seven after the fifth. From that to eight years old they are found to be large in proportion to the goodness of the pond, from eight to twelve inches. With regard to sea-fish, fishermen tell us, that a fish must be six years old before it is fit to be served up to a table. They instance it in the growth of a mackarel. They assure us, that those of a year old are as large as one's finger; that those of two years, are about twice that length; at three and four years, they are that small kind of a mackarel that have neither melts nor rows; and between five and six, they are those full grown fish that are served up to our tables. In the same manner, with regard to flat fishes, they tell us, that the turbot and barbel at one year are about the size of a crown-piece; the second year, as large as the palm of one's hand; and at the fifth and sixth year, they are large enough to be served up to table. Thus it appears that fish are a considerable time in coming to their full growth, and that they are a long time destroyed before it comes to their turn to be destroyers.

All fish prey upon each other, in some state of their existence. Those with the largest mouths, attack and devour the larger kinds; those whose mouths are less, lie in wait for the smaller fry; and even those chiefly subsist upon spawn. Of those which live in the ocean of the spinous kinds, the Dorado is the most voracious. This is chiefly found in the tropical climate; and is at once the most active, and beautiful of the finny region. It is about six feet long; the back all over enamelled with spots of a bluish green and silver; the tail and fins of a gold colour; and all have a brilliancy of tint, that nothing but Nature's pencil can attain to: the eyes are placed on each side of the head, large and beautiful, surrounded with circles of shining gold. In the seas where they are found, these fish are always in motion, and play round ships in full sail, with ease and security: for ever either pursuing or pursued, they are seen continually in a state of warfare; either defending themselves against the shark, or darting after the smaller fishes. Of all others, the flying-fish most abounds in these seas; and as it is a small animal, seldom growing above the size of a herring, it is chiefly sought by the dorado. Nature has furnished each respectively with the powers of pursuit and evasion. The dorado being above six feet long, yet not thicker than a salmon, and furnished with a full complement of fins, cuts its way through the water with amazing rapidity: on the other hand, the flying-fish is furnished with two pair of fins longer than the body, and these also moved by a stronger set of muscles than any other. This equality of power seems to furnish one of the most entertaining spectacles those seas can exhibit. The efforts to seize on the one side, and the arts of escaping on the other, are perfectly amusing. The dorado is seen, upon this occasion, darting after its prey, which will not leave the water, while it has the advantage of swimming, in the beginning of the chase. But, like a hunted hare, being tired at last, it then has recourse to another expedient for safety, by flight. The long fins, which began to grow useless in the water, are now exerted in a different manner and different direction to that in which they were employed in swimming: by this means, the timid little animal rises from the water, and flutters over its surface, for two or three hundred yards, till the muscles employed in moving the wings, are enfeebled by that mode of exertion. By this time they have acquired a fresh power of renewing their efforts in the water, and the animal is capable of proceeding with some velocity by swimming: but still the active enemy keeps it in view, and drives it again from the deep; till, at length, the poor little creature is seen to dart to shorter distances, to flutter with greater effort, and to drop down at last into the mouth of its fierce pursuer. But not the dorado alone, all Animated Nature seems combined against this little fish, which seems possessed of double powers, only to be subject to greater dangers. For though it should escape from its enemies of the deep, yet the tropic bird and the albatross are for ever upon the wing to seize it. Thus pursued in either element, it sometimes seeks refuge from a new enemy; and it is not unfrequent for whole shoals of them to fall on shipboard, where they furnish man with an object of useless curiosity.

The warfare in fresh water is not carried on with such destructive activity; nor are the inhabitants of that element so numerous. It would seem that there is something more favourable to the fecundity of fishes in the ocean, than in an element less impregnated with salt. It has been the opinion of some philosophers, that all fish are natives of that great reservoir; and that only colonies have been sent up rivers, either through accident, or the necessity of procuring subsistence. They have been led to this opinion by the superior fecundity of sea-fish, which breed twenty to one; as well as by their superiority in strength and size, over those of the same kind found in lakes and rivers. This is a matter too remotely speculative to be worth pursuing; but certain it is, that, in fresh water, fishes seem to abate much of their courage and rapacity; pursue each other with less violence, and seem to be less powerfully actuated by all their appetites. The greediness with which sea-fish devour the bait is prodigious, if compared with the manner they take it in fresh water. The lines of such fishermen as go off to sea, are coarse, thick, and clumsy, compared to what are used by those who fish at land. Their baits are seldom more than a piece of a fish, or the flesh of some quadruped, stuck on the hook in a bungling manner; and scarce any art is employed to conceal the deception. But it is otherwise in fresh water; the lines must often be drawn to a hair-like fineness; they must be tinctured of the colour of the stream; the bait must be formed with peculiar art, and even, if possible, to exceed the perfection of Nature: yet still the fishes approach it with diffidence, and often swim round it with disdain. The cod, on the banks of Newfoundland, the instant the hook, which is only baited with the guts of the animal last taken, is dropped into the water, darts to it at once, and the fishermen have but to pull up as fast as they throw down. But it is otherwise with those who fish in fresh waters; they must wait whole hours in fruitless expectation; and *the patience of a fisherman* is proverbial among us.

This comparative neglect of food, which is found in all the tribes of fresh water fishes, renders them less turbulent and destructive among each other. Of all these the pike is the most active and voracious; and our poets, whose business it is to observe the surface of Nature, have called it the tyrant of the watery plain. In fact, in proportion to its strength and celerity, the pike does some mischief; but what are its efforts compared to those of the cachalot or the shark! they resemble the petty depredations of a robber, put in competition with the ravages of a conqueror! However, the pike will attack every fish less than itself; and it is sometimes seen choaked, by attempting to swallow such as are too large a morsel. It is immaterial of what species the animal it pursues appears to be, whether of another or its own, all are indiscriminately devoured; so that every fish owes its safety to its minuteness, its celerity, or its courage: nor does the pike confine itself to feed on fish and frogs; it will draw down the water-rat and the young ducks, as they are swimming about. So great is their rapacity, that they will contend with the otter for his prey, and even endeavour to force it from him. For this reason it is dreaded by all other fish; and the small ones show the same uneasiness and detestation at the presence of their tyrant, as the little birds do at the sight of a hawk or an owl. When the pike lies asleep near the surface, as is frequently the case, the lesser fish are observed to swim around it in vast numbers, with a mixture of caution and terror.

The other tribes of fresh water fish are greatly inferior to this animal in courage and rapacity: they chiefly subsist upon worms and insects, pursuing them at the bottom, or jumping after them to the surface of the water. In winter also, their appetites seem entirely to forsake them; at least they continue in so torpid a state, that few baits will tempt them to their destruction. At that season, they forsake the shallow water, and seek those deep holes to be found in every river, where they continue for days together, without appearing to move. The cold seems to affect them; for they lie close to the bottom, where the water is most warm, and seldom venture out, except the day be very fine, and the shallows at the edges of the stream become tepified by the powerful rays of the sun. Some fishes may be rendered so torpid by the cold, in the northern rivers, as to be frozen up, in the great masses of ice, in which they continue for several months together, seemingly without life or sensation, the prisoners of congelation, and waiting the approach of a warmer sun, to restore them at once to life and liberty. Thus that cheerful luminary not only distributes health and vegetation to the productions of the earth, but is ardently sought even by the gelid inhabitants of the water.

As fish are enemies one to another, so each species is infested with worms of different kinds, peculiar to itself. The great fish abound with them; and the little ones are not entirely free. These troublesome vermin lodge themselves either in the jaws, and the intestines internally, or near the fins without. When fish are healthy and fat, they are not much annoyed by them; but in winter, when they are lean and sickly, they then suffer very much.

Nor does the reputed longevity of this class secure them from peculiar disorders. They are not only affected by too much cold, but there are frequently certain dispositions of the element in which they reside unfavourable to their health and propagation. Some ponds they will not breed in, however artfully disposed for supplying them with fresh recruits of water, as well as provision. In some seasons they are found to feel epidemic disorders, and are seen dead by the water side, without any apparent cause: yet still they are animals, of all others, the most vivacious, and often live and subsist upon such substances as are poisonous to more perfect classes of Animated Nature.

It is not easy to determine whether the poisonous qualities which many of them are found to possess, either when they wound our bodies externally with their spines, or when they are unwarily eaten at our tables, arises from this cause. That numbers of fishes inflict poisonous wounds, in the opinion of many cannot be doubted: the concurrent testimony of mankind, they think sufficient to contradict any reasonings upon this head, taken from anatomical inspection. The great pain that is felt from the sting given by the back fin of the weaver, bears no proportion to the smallness of the instrument that inflicts the wound. How the poison is preserved, or how it is conveyed by the animal, it is not in our power to perceive; but its actual existence has been often attested by painful experience. Satisfied with history we here decline conjecture.

The fact of their being poisonous when eaten, is equally notorious; and the cause equally inscrutable. My poor worthy friend, Dr. Grainger, who resided for many years at St. Christopher's, assured me, that of the fish caught, of the same kind, at one end of the island, some were the best and most wholesome in the world; while others taken at a different end, were always dangerous, and most commonly fatal. We have a paper in the Philosophical Transactions, giving an account of the poisonous qualities of those found at New Providence, one of the Bahama islands. The author assures us, that the greatest part of the fish of that dreary coast, are all of a deadly nature: their smallest effects being to bring on a terrible pain in the joints, which, if terminating favourably, leaves the patient without any appetite for several days after. It is not those of the most deformed figure, or the most frightful to look at, that are alone to be dreaded; all kinds, at different times, are alike dangerous; and the same species which has this day served for nourishment, is the next, if tried, found to be fatal!

This noxious quality has given rise to much speculation, and many conjectures. Some have supposed it to arise from the fishes on these shores eating of the manchineel apple, a deadly vegetable poison, that sometimes grows pendent over the sea: but the quantity of those trees growing in this manner, bears no proportion to the extensive infection of the fish. Labat has ascribed it to their eating the gally fish, which is itself most potently poisonous; but this only removes our wonder a little farther back; for it may be asked, with as just a cause for curiosity, how comes the gally fish itself to procure its noxious qualities? Others have ascribed the poison of these fishes to their feeding upon coperas beds: but I do not know of any coperas mines found in America. In short as we cannot describe the alembic by which the rattlesnake distils its malignity, nor the process by which the scorpion, that lives among roses, converts their sweets to venom, so we cannot discover the manner by which fishes become thus dangerous; and it is well for us of Europe that we can thus wonder in security. Certain it is that, with us, if fishes, such as carp or tench, acquire any disagreeable flavour from the lakes in which they have been bred, this can be removed, by their being kept some time in finer and better water: there they soon clear away all those disagreeable qualities their flesh had contracted, and become as delicate as if they had been always fed in the most cleanly manner. But this expedient is with us rather the precaution of luxury, than the effect of fear; we have nothing to dread from the noxious qualities of our fish; for all the animals our waters furnish are wholesome.

Happy England! where the sea furnishes an abundant and luxurious repast, and the fresh waters an innocent and harmless pastime; where the angler, in cheerful solitude, strolls by the edge of the stream, and fears neither the coiled snake, nor the lurking crocodile; where he can retire at night, with his few trouts, to borrow the pretty description of old Walton, to some friendly cottage, where the landlady is good, and the daughter innocent and beautiful; where the room is cleanly, with lavender in the sheets, and twenty ballads stuck about the wall! There he can enjoy the company of a talkative brother sportsman, have his trouts dressed for supper, tell tales, sing old tunes, or make a catch! There he can talk of the wonders of Nature with learned admiration, or find some harmless sport to content him, and pass away a little time without offence to God, or injury to man!

OF CRUSTACEOUS AND TESTACEOUS FISHES.

THE DIVISION OF SHELL FISH.

In describing the inhabitants of the water, a class of animals occur, that mankind, from the place of their residence, have been content to call fish; but which naturalists, from their formation, have justly agreed to be unworthy of the name. Indeed, the affinity many of this kind bear to the insect tribe, may very well plead for the historian who ranks them rather as insects. But the common language of a country must not be slightly invaded; the names of things may remain, if the philosopher be careful to give precision to our ideas of them.

There are two classes of animals, therefore, inhabiting the water, which commonly receive the name of fishes, entirely different from those we have been describing, and also very distinct from each other. These are divided by naturalists into Crustaceous and Testaceous Animals: both, totally unlike fishes to appearance, seem to invert the order of Nature, and as those have their bones on the inside, and their muscles hung upon them for the purposes of life and motion, these, on the contrary, have all their bony parts on the outside, and all their muscles within. But, not to indulge in a mysterious kind of language, it is evident, that all who have seen a lobster or an oyster, perceive that the shell in these bears a strong analogy to the bones of other animals; and that, by these shells, the animal is sustained and defended.

Crustaceous fish, such as the crab and the lobster, have a shell not quite of a stony hardness, but rather resembling a firm crust, and in some measure capable of yielding. Testaceous fishes, such as the oyster or cockle, are furnished with a shell of a stony hardness; very brittle, and incapable of yielding. Of the crustaceous kinds are the lobster, the crab, and the tortoise, of the testaceous, that numerous tribe of oysters, muscles, cockles, and sea-snails, which offer with infinite variety.

The crustaceous tribe appears to hold the middle rank between fishes, properly so called, and those snail-like animals that receive the name of testaceous fishes. Their muscles are strong and firm, as in the former; their shell is self-produced, as among the latter. They have motion, and hunt for food with great avidity, like the former. They are incapable of swimming, but creep along the bottom, like the latter: in short, they form the link that unites these two classes, that seem so very opposite in their natures.

Of testaceous fishes we shall speak hereafter. As to animals of the crustaceous kind, they are very numerous, their figure offers an hundred varieties; but as to their nature, they are obviously divided into two very distinct kinds, differing in their habits and their conformation. The chief of one kind is the lobster; the chief of the other, the tortoise. Under the lobster we rank the prawn, the craw-fish, the shrimp, the sea-crab, the land-crab, and all their varieties. Under the sea-tortoise, the turtle, the hawksbill-turtle, the land-tortoise, and their numerous varieties.

CRUSTACEOUS ANIMALS OF THE LOBSTER KIND.

However different in figure the lobster and the crab may seem, their manners and conformation are nearly the same. With all the voracious appetites of fishes, they are condemned to lead an insect life at the bottom of the water; and, though pressed by continual hunger, they are often obliged to wait till accident brings them their prey. Though without any warmth in their bodies, and even without red blood circulating through their veins, they are animals wonderfully voracious. Whatever they seize upon that has life, is sure to perish, though exceedingly well defended; they even devour each other: and, to increase our surprise still more, they may, in some measure, be said to eat themselves; for they change their shell and their stomach every year, and their old stomach is generally the first morsel that serves to glut the new.

The lobster is an animal of so extraordinary a form, that those who first see it are apt to mistake the head for the tail; but it is soon discovered that the animal moves with its claws foremost; and that the part which plays within itself by joints, like a coat of armour, is the tail. The two great claws are the lobster's instruments of provision and defence; these, by opening like a pair of nippers, have great strength and take a firm hold; they are usually notched like a saw, which still more increases their tenacity. Besides these powerful instruments, which may be considered as arms, the lobster has eight legs, four on each side, and these, with the tail, serve to give the animal its progressive and sideling motion. Between the two claws is the animal's head, very small, and furnished with eyes that seem like two black horny specks on each side; and these it has a power of advancing out of the socket, and drawing in at pleasure. The mouth, like that of insects, opens the long way of the body, not crossways, as with man, and the higher race of animals. It is furnished with two teeth for the comminution of its food; but, as these are not sufficient, it has three more in the stomach; one on each side, and the other below. Between the two teeth there is a fleshy substance, in the shape of a tongue. The intestines consist of one long bowel, which reaches from the mouth to the vent; but what this animal differs in from all others, is, that the spinal-marrow is in the breast-bone. It is furnished with two long feelers or horns, that issue on each side of the head, that seem to correct the dimness of its sight, and apprize the animal of its danger, or of its prey. The tail, or that jointed instrument at the other end, is the grand instrument of motion: and with this it can raise itself in the water. Under this we usually see lodged the spawn in great abundance; every pea adhering to the next by a very fine filament, which is scarcely perceivable. Every lobster is a hermaphrodite, and is supposed to be self-impregnated! The ovary, or place where the spawn is first produced, is backwards towards the tail, where a red substance is constantly found, and which is nothing but a cluster of peas, that are yet too small for exclusion. From this receptacle there go two canals, that open on each side at the jointures of the shell, at the belly; and through these passages the peas descend to be excluded, and placed under the tail, where the animal preserves them from danger for some time, until they come to maturity; when, being furnished with limbs and motion, they drop off into the water.

When the young lobsters leave the parent, they immediately seek for refuge in the smallest clefts of rocks, and in such like crevices at the bottom of the sea, where the entrance is but small, and the opening can be easily defended. There, without seeming to take any kind of food, they grow larger in a few weeks time, from the mere accidental substances which the water washes to their retreats. By this time, also, they acquire a hard firm shell, which furnishes them with both offensive and defensive armour. They then begin to issue from their fortresses, and boldly creep along the bottom, in hopes of meeting with more diminutive plunder. The spawn of fish, the smaller animals of their own kind, but chiefly the worms that keep at the bottom of the sea, supply them with plenty. They keep in this manner close among the rocks, busily employed in scratching up the sand with their claws for worms, or surprising such heedless animals as fall within their grasp: thus they have little to apprehend, except from each other; for in them, as among fishes, the large are the most formidable of all other enemies to the small.

But this life of abundance and security is soon to have a most dangerous interruption; for the body of the lobster still continuing to increase, while its shell remains unalterably the same, the animal becomes too large for its habitation, and imprisoned within the crust that has naturally gathered round it, there comes on a necessity of extricating itself. The young of this kind, therefore, that grow faster, as we are assured by the fishermen, change their shell oftener than the old, who come to their full growth, and who remain in the same shell often for two years together. In general, however, all these animals change their shell once a-year; and this is not only a most painful operation, but also subjects them to every danger. Their moulting season is generally about the beginning of summer, at which time their food is in plenty, and their strength and vigour in the highest perfection. But soon all their activity ceases; they are observed forsaking the open parts of the deep, and seeking some retired situation among the rocks, or some outlet where they may remain in safety from the attacks of their various enemies. For some days previous to their change, the animal discontinues its usual voraciousness; it is no longer seen laboriously harrowing up the sand at the bottom, or fighting with others of its kind, or hunting its prey; it lies torpid and motionless, as if in anxious expectation of the approaching change. Just before casting its shell, it throws itself upon its back, strikes its claws against each other, and every limb seems to tremble; its feelers are agitated, and the whole body is in violent motion; it then swells itself in an unusual manner, and at last the shell is seen beginning to divide at its junctures; particularly it opens at the junctures of the belly, where, like a pair of jumps, it was before but seemingly united. It also seems turned inside out, and its stomach comes away with its shell. After this, by the same operation, it disengages itself of the claws, which burst at the joints; the animal, with a tremulous motion, casting them off as a man would kick off a boot that was too big for him.

Thus, in a short time, this wonderful creature finds itself at liberty; but in so weak and enfeebled a state, that it continues for several hours motionless. Indeed, so violent and painful is the operation, that many of them die under it; and those who survive are in so weak a state for some time, that they neither take food nor venture from their retreats. Immediately after this change, they have not only the softness but the timidity of a worm. Every animal of the deep is then a powerful enemy, which they can neither escape nor oppose; and this, in fact, is the time when the dog-fish, the cod, and the ray, devour them by hundreds. But this state of defenceless imbecility continues for a very short space of time: the animal, in less than two days, is perceived to have the skin that covered its body grown almost as hard as before; its appetite also is observed to increase; and, strange to behold, the first object that tempts its gluttony, is its own stomach, which it was so lately disengaged from! This it devours with great eagerness; and sometimes after eats even its former shell. In about forty-eight hours, in proportion to the animal's health and strength, the new shell is perfectly formed, and as hard as that which was but just thrown aside.

To contribute to the speedy growth of the shell, it is supposed by some, that the lobster is supplied with a very extraordinary concretion within its body, that is converted into the shelly substance. It is of a chalky nature, found in the lower part of the stomach of all lobsters, improperly called crab's eyes, and sold under that title in the shops. About the time the lobster quits its shell, the teeth in its stomach break these stones to pieces, and the fluids contained therein dissolve them. This fluid, which still remains in the new stomach, is thought to be replete with a petrifying quality, proper for forming a new shell; but the concreting power that first formed these, shows a sufficient power in the animal to produce also the shell; and it is going but a short way in the causes of things when we attempt to explain one wonder by another.

When the lobster is completely equipped in its new shell, it then appears how much it has grown in the space of a very few days; the dimensions of the old shell being compared with those of the new, it will be found that the creature is increased above a third in its size; and, like a boy that has outgrown his clothes, it seems wonderful how the deserted shell was able to contain so great an animal as entirely fills up the new.

The creature thus furnished, not only with a complete covering, but also with a greater share of strength and courage, ventures more boldly among the animals at the bottom; and not a week passes, that, in its combats, it does not suffer some mutilation. A joint, or even a whole claw, is sometimes snapped off in these encounters. At certain seasons of the year, these animals never meet each other without an engagement. In these, to escape with the loss of a leg, or even a claw, is considered as no great calamity; the victor carries off the spoil to feast upon at leisure, while the other retires from the defeat to wait for a thorough repair. This repair it is not long in procuring. From the place where the joint of the claw was cut away, is seen in a most surprising manner to bourgeon out the beginning of a new claw. This, if observed, at first, is small and tender, but grows, in the space of three weeks, to be almost as large and as powerful as the old one. I say almost as large, for it never arrives to the full size; and this is the reason we generally find the claws of lobsters of unequal magnitude.

After what has been thus described, let us pause a little, to reflect on the wonders this extraordinary creature offers to our imagination! An animal without bones on the inside, yet furnished with a stomach capable of digesting the hardest substances, the shells of muscles, of oysters, and even its own; an animal gaining a new stomach and a new shell at stated intervals! Furnished with the instruments of propagation double in both sexes; and yet with an apparent incapacity of uniting! Without red blood circulating through the body, and yet apparently vigorous and active! But, most strange of all, an animal endowed with a vital principle that furnishes out such limbs as have been cut away, and keeps continually combating it, though in constant repair to renew its engagements! These are but a small part of the wonders of the deep, where Nature sports without a spectator!

Of this extraordinary yet well known animal there are many varieties, with some differences in the claws, but little in the habits or conformation. It is found above three feet long; and if we may admit the shrimp and the prawn into the class, though unfurnished with claws, it is seen not above an inch. These all live in the water, and can bear its absence for but a few hours. The shell is black when taken out of the water, but turns red by boiling. The most common way of taking the lobster is in a basket, or pot, as it is termed by fishermen, made of wicker-work, in which they put the bait, and then throw it to the bottom of the sea, in six or ten fathoms water. The lobsters creep into this for the sake of the bait, but are not able to get out again. The river craw-fish differs little from the lobster, but that the one will live only in fresh water, and the other will thrive only in the sea.

The crab is an animal found equally in fresh and salt water; as well upon land as in the ocean. In shape it differs very much from the lobster, but entirely resembles it in habits and conformation. The tail in this animal is not so apparent as in the former, being that broad flap that seems to cover a part of the belly, and when lifted discovers the peas or spawn, situated there in great abundance. It resembles the lobster in the number of its claws, which are two, and its legs, which are eight, four on either side. Like the lobster, it is a bold voracious animal; and such an enmity do crabs bear each other, that those who carry them for sale to market, often tie their claws with strings to prevent their fighting and maiming themselves by the way. In short, it resembles the lobster in every thing but the amazing bulk of its body compared to the size of its head, and the length of its intestines, which have many convolutions.

But as the crab is found upon land as well as in water, the peculiarity of its situation produces a difference in its habitudes, which it is proper to describe. The land crab is found in some of the warmer regions of Europe, and in great abundance in all the tropical climates in Africa and America. They are of various kinds, and endued with various properties; some being healthful, delicious, and nourishing food; others poisonous or malignant to the last degree; some are not above half an inch broad, others are found a foot over; some are of a dirty brown, and others beautifully mottled. That animal called the violet crab of the Carribbee Islands, is the most noted both for the shape, the delicacy of its flesh, and the singularity of its manners.

The violet crab in some measure resembles two hands cut through the middle and joined together; for each side looks like four fingers, and the two nippers or claws resemble the thumbs. All the rest of the body is covered with a shell as large as a man's hand and bunched in the middle, on the fore part of which there are two long eyes of the size of a grain of barley, as transparent as crystal, and as hard as horn. A little below these is the mouth, covered with a sort of barbs, under which there are two broad sharp teeth as white as snow. They are not placed, as in other animals, crossways, but in the opposite direction, not much unlike the blades of a pair of scissars. With these teeth they can easily cut leaves, fruits, and rotten wood, which is their usual food. But their principal instruments for cutting and seizing their food is their nippers, which take such a hold, that the animal loses the limb sooner than its grasp, and is often seen scampering off, having left its claws still holding fast upon the enemy.—The faithful claw seems to perform its duty, and keeps for above a minute fastened upon the finger while the crab is making off. In fact, it loses no great matter by leaving a leg or an arm, for they soon grow again, and the animal is found as perfect as before.

This, however, is the least surprising part of this creature's history; and what we are about to relate, were it not as well known and as confidently confirmed as any other circumstance in natural history, it might well stagger our belief. These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly once a-year march down to the seaside in a body of some millions at a time. As they multiply in great numbers, they choose the months of April or May to begin their expedition; and then they sally out by thousands from the stumps of hollow trees, from the clefts of the rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them. The sea is their place of destination, and to that they direct their march with right-lined precision. No geomatrician could send them to their destined station by a shorter course; they neither turn to the right nor left, whatever obstacles intervene; and even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But though this be the general order of their route, they upon other occasions are compelled to conform to the face of the country; and if it be intersected by rivers, they are then observed to wind along the course of the stream. The procession sets forward from the mountains with the regularity of an army, under the guidance of an experienced commander. They are commonly divided into three battalions; of which, the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. These are often obliged to halt for want of rain, and go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular battalia, being formed into columns of fifty paces broad and three miles deep, and so close that they almost cover the ground. In about three or four days after this, the rear-guard follows; a straggling, undisciplined tribe, consisting of males and females, but neither so robust nor so numerous as the former. The night is their chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion; and they continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make an universal halt, and wait for the cool of the evening to pursue their operations. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for they often clatter their nippers together, as if it were to threaten those that come to disturb them. But though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident is maimed in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey.

When, after a fatiguing march and escaping a thousand dangers (for they are sometimes three months in getting to the shore) they have arrived at their destined port, they prepare to cast their spawn. The peas are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of the sea water to help the parturition. For this purpose, the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing the spawn to maturity; for without farther delay they withdraw to seek a lodging upon land: in the mean time, the spawn grows larger, is excluded out of the body, and adheres to the barbs under the flap, or more properly the tail. This bunch is perceived as large as a hen's egg, and exactly resembling the roes of herrings. In this state, they once more seek the shore, which is the last time, and, shaking off their spawn into the water, leave accident to bring it to maturity. At this period whole shoals of hungry fish are arrived at the shore in expectation of this annual supply; the sea to a great distance seems black with them; and about two-thirds of the crabs-eggs are immediately devoured by these rapacious invaders. The eggs that escape are hatched under the sand; and soon after millions at a time of these little crabs are seen quitting the shore, and slowly travelling up to the mountains.

But the old ones are not so active to return; they have become so feeble and lean, that they can scarcely creep along, and the flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave as it were quite whole, the place where they opened on the belly being unseen. At that period they are quite naked, and almost without motion for six days together, when they become so fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and when they arrive at perfection are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks.

This animal when possessed of its retreats in the mountains is impregnable; for only subsisting upon vegetables, it seldom ventures out; and its habitation being in the most inaccessible places, it remains for a great part of the season in a state of perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands; but disregarding the bodies, they only seek for that small spawn which lies on each side of the stomach within the shell; of about the thickness of a man's thumb. They are considerably more valuable upon their return after they have cast their shell; for being covered with a skin resembling soft parchment, almost every part, except the stomach, may be eaten. They are taken in their holes by feeling for them in the ground with an instrument: they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dextrous crab-catcher takes them by the hinder legs in such a manner, that its nippers cannot touch him, and thus he throws it into his bag. Sometimes also they are caught when they take refuge at the bottom of holes, in rocks by the sea-side, by clapping a stick at the mouth of the hole, which prevents their getting out; and then soon after the tide coming, enters the hole, and the animal is found, upon its retiring, drowned in its retreat.

These crabs are of considerable advantage to the natives; and the slaves very often feed entirely upon them. In Jamaica, where they are found in great plenty, they are considered as one of the greatest delicacies of the place.—Yet still, the eating of them is attended with some danger; for even of this kind many are found poisonous, being fed, as it is thought, upon the manchineel apple; and whenever they are found under that noxious plant, they are always rejected with caution. It is thus with almost all the productions of those luxurious climates; however tempting they may be to the appetite, they but too often are found destructive; and there is scarcely a delicacy among them that does not carry its own alloy.

The descent of these creatures for such important purposes, deserves our admiration; but there is an animal of the lobster kind that annually comes down from its mountains in like manner, and for purposes still more important and various. Its descent is not only to produce an offspring, but to provide itself a covering; not only to secure a family, but to furnish a house. The animal I mean is the soldier-crab, which has some similitude to the lobster, if divested of its shell. It is usually about four inches long, has no shell behind, but is covered down to the tail with a rough skin, terminating in a point. It is, however, armed with strong hard nippers before, like the lobster; and one of them is as thick as a man's thumb, and pinches most powerfully. It is, as I said, without a shell to any part except its nippers; but what Nature has denied this animal, it takes care to supply by art; and taking possession of the deserted shell of some other animal, it resides in it, till, by growing too large for its habitation, it is under a necessity of change. It is a native of the West India islands; and, like the former, it is seen every year descending from the mountains to the sea-shore, to deposit its spawn, and to provide itself with a new shell. This is a most bustling time with it, having so many things to do; and, in fact, it appears to be very busy. It is probable that its first care is to provide for its offspring before it attends to its own wants; and it is thought, from the number of little shells which it is seen examining, that it deposits its spawn in them, which is thus placed in perfect security till the time of exclusion.

However this be, the soldier is in the end by no means unmindful of itself. It is still seen in its old shell, which it appears to have considerably outgrown; for a part of the naked body is seen at the mouth of it, which the habitation is too small to hide. A shell, therefore, is to be found large enough to cover the whole body; and yet not so large as to be unmanageable and unwieldy. To answer both these ends it is no easy matter, nor the attainment of a slight inquiry. The little soldier is seen busily parading the shore along that line of pebbles and shells that is formed by the extremest wave; still, however, dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it and passing it by, going on to another, contemplating that for a while, and then slipping its tail from its old habitation, to try on the new. This also is found to be inconvenient; and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all.—*Vide Peru du Testre.*

Yet it is not till after many trials, but frequently many combats also, that the soldier is thus completely equipped; for there is often a contest between two of them for some well-looking favourite shell for which they are rivals. They both endeavour to take possession; they strike with their claws, they bite each other, till the weakest is obliged to yield, by giving up the object of dispute. It is then that the victor immediately takes possession, and parades it in his new conquest three or four times back and forward upon the strand before his envious antagonist.

When this animal is taken, it sends forth a feeble cry, and endeavours to seize the enemy with its nippers; which if it fastens upon it will sooner die than quit the grasp. The wound is very painful, and not easily cured. For this reason, and as it is not much esteemed for its flesh, it is generally permitted to return to its old retreat to the mountains in safety. There it remains till the necessity of changing once more, and the desire of producing an offspring, expose it to fresh dangers the year ensuing.

OF THE TORTOISE AND ITS KINDS.

Having described the lobster and the crab as animals in some measure approaching to the insect tribes, it will appear like injustice to place the tortoise among the number, that, from its strength, its docility, the warm red blood that is circulating in its veins, deserves to be ranked even above the fishes. But as this animal is covered, like the lobster, with a shell; as it is of an amphibious nature, and brings forth its young from the egg without hatching, we must be content to degrade it among animals that in every respect it infinitely surpasses.

Tortoises are usually divided into those that live upon land, and those that subsist in the water; and use has made a distinction even in the name; the one being called tortoises, the other turtles. However, Seba has proved that all tortoises are amphibious; that the land tortoise will live in the water, and that the sea turtle can be fed upon land. A land tortoise was brought to him which was caught in one of the canals of Amsterdam, which he kept for half a year in his house, where it lived very well contented in both elements. When in the water it remained with its head above the surface; when placed in the sun, it seemed delighted with its beams, and continued immoveable while it felt their warmth. The difference, therefore, in these animals, arises rather from their habits than their conformation; and, upon examination, there will be less variety found between them than between birds that live upon land, and those that swim upon the water.

Yet, though Nature seems to have made but few distinctions among these animals, as to their conformation, yet, in their habits, they are very dissimilar; as these result from the different qualities of their food, and the different sorts of enemies they have to avoid or encounter. I will therefore exhibit their figure and conformation under one common description, by which their slight differences will be more obvious; and then I shall give a separate history of the manners of each, as naturalists and travellers have taught us.

All tortoises, in their external form, pretty much resemble each other; their outward covering being composed of two great shells, the one laid upon the other, and only touching at the edges: however, when we take a closer and more perfect view, we shall find that the upper shell is composed of no less than thirteen pieces, which are laid flat upon the ribs, like the tiles of a house, by which the shell is kept arched and supported. The shells both above and below, that, which seem, to an inattentive observer, to make each but one piece, are bound together at the edges by very strong and hard ligaments, yet with some small share of motion. There are two holes at either edge of this vaulted body; one for a very small head, shoulders, and arms, to peep through; the other at the opposite edge, for the feet and the tail. These shells the animal is never disengaged from; and they serve for its defence against every creature but man.

The tortoise has but a small head, with no teeth; but it is furnished with two bony ridges in the place, serrated and hard. These serve to gather and grind its food; and such is the amazing strength of the jaws, that it is impossible to open them where they have once fastened. Even when the head is cut off, the jaws still keep their hold; and the muscles, in death, preserve a tenacious rigidity. Indeed, the animal is possessed of equal strength in all other parts of its body: the legs, though short, are inconceivably strong: and torpid as the tortoise may appear, it has been known to carry five men standing upon his back, with apparent ease and unconcern. Its manner of going forward is by moving its legs one after the other; and the claws with which the toes are furnished, sink into the ground like the nails of an iron-shod wheel, and assist its progress.

With respect to its internal parts, not to enter into minute anatomical, disquisitions, it may not be improper to observe, that the blood circulates in this animal as in some cartilaginous fishes, and something in the manner of a child in the womb. The greatest quantity of the blood passes directly from the vena cava into the left ventricle of the heart, which communicates with the right ventricle by an opening; while the auricles only receive what the ventricles seem incapable of admitting. Thus the blood is driven by a very short passage through the circulation; and the lungs seem to lend only occasional assistance. From this conformation the animal can subsist for some time, without using the lungs or breathing; at least, the lungs are not so necessary an instrument for driving on the circulation as with the human race.

Such is the general structure of this animal, whether found to live by land or water. With regard to the differences of these animals, the land-tortoise, from its habits of making use of its feet in walking, is much more nimble upon land than the sea-turtle: the land-tortoise, if thrown upon its back, by rocking and balancing its body, like a child rocking in a cradle, at last turns itself upon its face again; but the turtle, when once turned, continues without being able to move from the spot. In comparing the feet also of these animals, we observe, that the nails upon the toes of one that has been used to scratch for subsistence upon land, are blunt and worn; while those that have only been employed in swimming, are sharp and long, and have more the similitude of fins. The brain of the land-tortoise is but small; and yet it is three times as large as that of the turtle. There is a difference also in the shape of their eggs, and in the passage by which they are excluded; for, in the land-tortoise, the passage is so narrow, that the egg conforms to the shape of the aperture, and though round when in the body, yet becomes much more oblong than those of fowls, upon being excluded; otherwise they would never be able to pass through the bony canal by which they are protruded: on the contrary, the passage is wider in the turtle, and therefore its eggs are round. These are the most striking distinctions; but that which is most known is their size; the land-tortoise often not exceeding three feet long, by two feet broad; the sea-turtle being sometimes from five to seven feet long. The size, however, is but a fallacious distinction; since land-tortoises, in some parts of India, grow to a surprising magnitude; though probably not, as some of the ancients affirm, big enough for a single shell to serve for the covering of a house.

But if the different kinds of tortoises are not sufficiently distinguished by their figure, they are very obviously distinguishable by their methods of living. The land-tortoise lives in holes dug in the mountains, or near marshy lakes; the sea-turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with, and burrow in the ground; the turtle chiefly uses its feet in swimming, or creeping at the bottom.

The land-tortoise is generally found, as was before observed, from one foot to five feet long, from the end of the snout to the end of the tail; and from five inches to a foot and a half across the back. It has a small head, somewhat resembling that of a serpent; an eye without the upper lid; the under eye-lid serving to cover and keep that organ in safety. It has a strong scaly tail, like the lizard. Its head the animal can put out and hide at pleasure, under the great penthouse of its shell: there it can remain secure from all attacks; there, defended on every side, it can fatigue the patience of the most formidable animal of the forest, that makes use only of natural strength to destroy it. As the tortoise lives entirely upon vegetable food, it never seeks the encounter; yet, if any of the smaller animals attempt to invade its repose, they are sure to suffer. The tortoise, impregnably defended, is furnished with such a strength of jaw, that, though armed only with bony plates instead of teeth, wherever it fastens, it infallibly keeps its hold, until it has taken out the piece.

Though peaceable in itself, this animal is formed for war in another respect, for it seems almost endued with immortality. Nothing can kill it; the depriving it of one of its members, is but a slight injury: it will live, though deprived of the brain; it will live, though deprived of its head. Rhedi informs us, that in making some experiments upon vital motion, he, in the beginning of the month of November, took a land-tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise marched away without appearing to have received the smallest injury; only it shut the eyes, and never opened them afterwards. Soon after the hole in the skull was seen to close; and, in three days, there was a complete skin covering the wound. In this manner the animal lived without a brain, for six months; walking about unconcernedly, and moving its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still farther; for he cut off the head, and the animal lived twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castinets, for above a quarter of an hour.

Nor are these animals less long-lived than difficult in destroying. Tortoises are commonly known to exceed eighty years old; and there was one kept in the Archbishop of Canterbury's garden, at Lambeth, that was remembered above a hundred and twenty. It was at last killed by the severity of a frost, from which it had not sufficiently defended itself in its winter retreat, which was a heap of sand at the bottom of the garden.

The usual food of the land-tortoise seems not so nourishing as to supply this extraordinary principle of vitality. It lives upon vegetables in its retreats in the mountains or the plain; and seldom makes its prey of snails or worms, but when other food is not to be found in grateful plenty. It is fond also of fruits; and when the forest affords them, is generally found not far from where they grow. As it can move but slowly, it is not very delicate in the choice of its food; so that it usually fills itself with whatever offers. Those that are kept in a domestic state, will eat any thing; leaves, fruits, corn, bran, or grass.

From the smallness of its brain, and the slowness of its motion, it obviously appears to be a torpid, heavy animal, requiring rest and sleep; and, in fact, it retires to some cavern to sleep during the winter. I already observed that its blood circulated through the heart by a short passage; and that it did not, as anatomists express it, go through the great circulation. With the human species, and quadrupeds, the blood goes from the veins to the heart; from the heart it is sent to be spread over the lungs; from the lungs it returns to the heart again; and from thence it goes to the arteries to be distributed through the whole body. But its passage in the tortoise is much shorter; for, from the veins it goes to the heart; then leaving the lungs entirely out of its course, it takes a short cut, if I may so say, into the beginning of the arteries, which send it round the animal frame. From hence we perceive the lungs are left out of the circulation; and, consequently, the animal is capable of continuing to live without continuing to breathe. In this it resembles the bat, the serpent, the mole, and the lizard; like them it takes up its dark residence for the winter; and, at that period, when its food is no longer in plenty, it happily becomes insensible to the want. Nor is it unmindful to prepare its retreat, and make it as convenient as possible; it is sometimes buried two or three feet in the ground, with its hole furnished with moss, grass, and other substances, as well to keep the retreat warm, as to serve for food, in case it should prematurely wake from its state of stupefaction. But it must not be supposed that, while it is thus at rest, it totally discontinues to breathe; on the contrary, an animal of this kind, if put into a close vessel, without air, will soon be stifled; though not so readily as in a state of vigour and activity.

From this dormant state the tortoise is awakened by the genial return of spring; and is supposed not to be much wasted by its long confinement. To animals that live an hundred and fifty years, a sleep of six months is but as the nap of a night. All the actions of these long-lived creatures seem formed upon a scale answering the length of their existence: their slumbers are for a season; their motions are slow, and require time in every action. About a month after their enlargement from a torpid state, they prepare to transmit their posterity; and both the male and the female continue together for near a month. The eggs of the female are contained in the ovary, above the bladder, which is extremely large; and these are before their exclusion, round and naked, with some spots of red; after they are laid, however, they assume another form, being smaller and longer than those of a hen. This alteration in the figure of the eggs most probably proceeds from the narrowness of the bony passage through which they are excluded. Swammerdam, who compared the size of the eggs taken out of this animal's body with the diameter of the passage through which they are excluded, was of opinion that the bones themselves separated from each other, and closed again; but, in my opinion, it is more probable to suppose, that the eggs, and not the bones, alter their form. Certain it is, that they are round in the body, and that they are oval upon being protruded.

The eggs of all the tortoise kind, like those of birds, are furnished with a yolk and a white; but the shell is different, being somewhat like those soft eggs that hens exclude before their time: however, this shell is much thicker and stronger, and is a longer time in coming to maturity in the womb. The land tortoise lays but a few in number, if compared to the sea-turtle, who deposits from a hundred and fifty to two hundred in a season.

The amount of the land tortoise's eggs I have not been able to learn; but, from the scarceness of the animal, I am apt to think they cannot be very numerous. When it prepares to lay, the female scratches a slight depression in the earth, generally in a warm situation, where the beams of the sun have their full effect: there depositing her eggs, and covering them with grass and leaves, she forsakes them to be hatched by the heat of the season. The young tortoises are generally excluded in about twenty-six days; but as the heat of the weather assists, or its coldness retards incubation, sometimes it happens that there is a difference of two or three days. The little animals no sooner leave the egg than they seek for their provision, entirely self-taught; and their shell, with which they are covered from the beginning, expands and grows larger with age: as it is composed of a variety of pieces, they are all capable of extension at their sutures, and the shell admits of increase in every direction. It is otherwise, however, with those animals, like the lobster, whose shell is composed all of one piece, that admits of no increase; which, when the tenant is too big for the habitation, must burst the shell, and get another. But the covering of the tortoise grows larger in proportion as the internal parts expand; in some measure resembling the growth of the human skull, which is composed of a number of bones, increasing in size proportionably to the quantity of the brain. All tortoises, therefore, as they never change their shell, must have it formed in pieces; and though, in some that have been described by painters or historians, these marks have not been attended to, yet we can have no doubt that they are general to the whole tribe.

It is common enough to take these animals into gardens, as they are thought to destroy insects and snails in great abundance. We are even told that in hot countries, they are admitted into a domestic state, as they are great destroyers of bugs. How so large and heavy an animal is capable of being expert at such petty prey, is, perhaps, not easy to conceive; but I have seen several of them about gentlemen's houses, that, in general, appear torpid, harmless, and even fond of employment. Children have sometimes got upon the back of a tortoise; and such was the creature's strength, that it never seemed overloaded, but moved off with its burden to where it expected to be fed, but would carry them no further. In winter they regularly find out a place to sleep in; but in those warm countries in which the tortoise is found larger, and in greater plenty than in Europe, they live, without retiring, throughout the year.

The sea tortoise, or turtle, as it is now called, is generally found larger than the former. This element is possessed with the property of increasing the magnitude of those animals, which are common to the land and the ocean. The sea pike is larger than that of fresh water; the sea bear is larger than that of the mountains; and the sea turtle exceeds the land tortoise in the same proportion. It is of different magnitudes, according to its different kinds; some turtles being not above fifty pounds weight, and some above eight hundred.

The great Mediterranean turtle is the largest of the turtle kind with which we are acquainted. It is found from five to eight feet long, and from six to nine hundred pounds weight. But, unluckily, its utility bears no proportion to its size; as it is unfit for food, and sometimes poisons those who eat it. The shell also, which is a tough, strong integument, resembling an hide, is unfit for all serviceable purposes. One of these animals was taken in the year 1729, at the mouth of the Loire, in nets that were not designed for so large a capture. This turtle, which was of enormous strength, by its own struggles involved itself in the nets in such a manner as to be incapable of doing mischief: yet, though thus shackled, it appeared terrible to the fishermen, who were at first for flying; but finding it impotent, they gathered courage to drag it on shore, where it made a most horrible bellowing; and when they began to knock it on the head with their gaffs, it was to be heard at half a mile's distance. They were still further intimidated by its nauseous and pestilential breath, which so powerfully affected them, that they were near fainting. This animal wanted but four inches of being eight feet long, and was above two feet over: its shell more resembled leather than the shell of a tortoise; and, unlike all other animals of this kind, it was furnished with teeth in each jaw, one rank behind another, like those of a shark: its feet also, different from the rest of this kind, wanted claws; and the tail was quite disengaged from the shell, and fifteen inches long, more resembling that of a quadruped than a tortoise. This animal was then unknown upon the coasts of France, and was supposed to have been brought into the European seas, in some India ship that might be wrecked upon her return. Since that, however, two or three of these animals have been taken upon the coasts; two in particular upon those of Cornwall, in the year 1756, the largest of which weighed eight hundred pounds; and one upon the Isle of Rhé, but two years before that, weighed between seven and eight hundred. One, most probably of this kind also, was caught about fifty years ago near Scarborough, and a good deal of company was invited to feast upon it: a gentleman, who was one of the guests, told the company that it was a Mediterranean turtle, and not wholesome; but a person, who was willing to satisfy his appetite at the risk of his life, ate of it: he was seized with a violent vomiting and purging; but his constitution overpowered the malignity of the poison.

These are a formidable and useless kind, if compared to the turtle caught in the South Seas and the Indian Ocean. These are of different kinds; not only unlike each other in form, but furnishing man with very different advantages. They are usually distinguished by sailors into four kinds; the trunk turtle, the loggerhead, the hawksbill, and the green turtle.

The trunk turtle is commonly larger than the rest, and its back higher and rounder. The flesh of this is rank, and not very wholesome.

The loggerhead is so called from the largeness of its head, which is considerably bigger in proportion than that of the other kinds. The flesh of this is also very rank, and not eaten but in case of necessity.

The hawksbill turtle is the least of the four, and has a long and small mouth, somewhat resembling the bill of a hawk. The flesh of this also is very indifferent eating; but the shell serves for the most valuable purposes. This is the animal that supplies the tortoise-shell, of which such a variety of beautiful trinkets are made. The substance of which the shells of other turtles are composed, is thin and porous; but that of the hawksbill is firm, and when polished is marbled in a most beautiful manner. They generally carry about three pounds; but the largest of all six pounds. The shell consists, as in all the kind, of thirteen leaves or plaits, of which eight are flat, and five hollow. They are raised and taken off by means of fire, which is made under the shell after the flesh is taken out. As soon as the heat affects the leaves, they start from the ribs, and are easily raised with the point of a knife. By being scraped and polished on both sides, they become handsomely transparent, or are easily cast into what form the workman thinks proper, by making them soft and pliant in warm water, and then screwing them in a mold, like a medal: the shell, however, is most beautiful before it undergoes this last operation.

But of all animals of the tortoise kind, the green turtle is the most noted, and the most valuable. The delicacy of its flesh, and its nutritive qualities, together with the property of being easily digested, were, for above a century, known only to our seamen and the inhabitants of the coasts where they were taken. It was not till by slow degrees the distinction came to be made between such as were malignant and such as were wholesome. The controversies and contradictions of our old travellers were numerous upon this head: some positively asserting, that the turtle was delicious food; while others, on the contrary, declared that it was actual poison. Dampier, that rough seaman, who has added more to natural history than half the philosophers that went before him, appears to be the first who informed us of their distinctions; and that, while the rest might be valuable for other purposes, the green turtle alone was chiefly prized for the delicacy of its flesh. He never imagined, however, that this animal would make its way to the luxurious tables of Europe; for he seems chiefly to recommend it as salted up for ship's provision, in case of necessity.

At present the turtle is very well known among us, and is become the favourite food of those that are desirous of eating a great deal without the danger of surfeiting. This is a property the flesh of the turtle seems peculiarly possessed of; and by the importation of it alive among us, gluttony is freed from one of its greatest restraints. The flesh of the turtle is become a branch of commerce; and therefore ships are provided with conveniences for supplying them with water and provision, to bring them over in health from Jamaica and other West India islands. This, however, is not always effected; for though they are very vivacious, and scarcely require any provision upon the voyage, yet, by the working of the ship and their beating against the side of the boat that contains them, they become battered and lean; so that to eat this animal in the highest perfection, instead of bringing the turtle to the epicure, he ought to be transported to the turtle.

The animal is called the green turtle, from the colour of its shell, which is rather greener than that of others of this kind. It is generally found about two hundred weight; though some are five hundred, and others not above fifty. Dampier tells us of one that was seen at Port-Royal in Jamaica, that was six feet broad across the back; he does not tell us its other dimensions; but says, that the son of Captain Roach, a boy about ten years old, sailed in the shell, as in a boat, from the shore to his father's ship, which was above a quarter of a mile from land. But this is nothing to the size of some turtles the ancients speak of. Ælian assures us, that the houses in the island of Taprobane are usually covered with a single shell. Diodorus Siculus tells us, that a people dwelling in the neighbourhood of Ethiopia, called the *Turtle-eaters*, coasted along the shore in boats made of the upper shell of this animal; and that in war, when they had eaten the flesh, the covering served them as a tent. In this account, Pliny, and all the rest of the ancients agree; and as they had frequent opportunities of knowing the truth, we are not lightly to contradict their testimony.

At present, however, they are not seen of such amazing dimensions. We are told, by Laet, that on the isle of Cuba they grow to such a size, as that five men can stand on the back of one of them together, and, what is more surprising still, that the animal does not seem overloaded, but will go off with them upon its back, with a slow steady motion towards the sea.

They are found in the greatest numbers on the island of Ascension; where, for several years, they were taken to be salted to feed the slaves, or for a supply of ship's provision. Their value at present seems to be better known.

This animal seldom comes from the sea but to deposit its eggs, and now and then to sport in fresh water. Its chief food is a submarine plant, which covers the bottom of several parts of the sea not far from the shore. There the turtles are seen, when the weather is fair, feeding in great numbers, like flocks of sheep, several fathoms deep upon the verdant carpet below. At other times they go to the mouths of rivers; and they seem to find gratification in fresh water. After some time thus employed, they seek their former stations: and when done feeding, they generally float with their heads above water, unless they are alarmed by the approach of hunters or birds of prey, in which case they suddenly plunge to the bottom. They often seek their provision among the rocks, feeding upon moss and sea-weed; and it is probable that they will not disdain to prey upon insects and other small animals, as they are very fond of flesh when taken and fed for the table.

At the time of breeding, they are observed to forsake their former haunts and their food, and to take sometimes a voyage of nine hundred miles to deposit their eggs on some favourite shore. The coasts they always resort to upon these occasions are those that are low, flat, and sandy; for being heavy animals, they cannot climb a bold shore; nor is any bed so proper as sand to lay their eggs on. They couple in March, and continue united till May.

When the time for laying approaches, the female is seen towards the setting of the sun drawing near the shore, and looking earnestly about her, as if afraid of being discovered. When she perceives any person on shore, she seeks for another place; but if otherwise, she lands when it is dark, and goes to take a survey of the sand where she designs to lay. Having marked the spot, she goes back without laying for that night, to the ocean again; but the next night returns to deposit a part of her burden. She begins by working and digging in the sand with her fore-feet till she has made a round hole, a foot broad and a foot and a half deep, just at the place a little above where the water reaches highest. This done, she lays eighty or ninety eggs at a time, each as big as a hen's egg, and as round as a ball. She continues laying about the space of an hour; during which time, if a cart were driven over her, she would not be induced to stir. The eggs are covered with a tough white skin, like wetted parchment. When she has finished laying, she covers the hole so dexterously, that it is no easy matter to find the place; and those must be accustomed to the search to make the discovery. When the turtle has done laying she returns to the sea, and leaves her eggs to be hatched by the heat of the sun. At the end of fifteen days she lays about the same number of eggs again; and at the end of another fifteen days she repeats the same; three times in all, using the same precautions every time for their safety.

In about twenty-four or twenty-five days after laying, the eggs are hatched by the heat of the sun; and the young turtles, being about as big as quails, are seen bursting from the sand, as if earth-born, and running directly to the sea, with instinct only for their guide: but, to their great misfortune, it often happens that, their strength being small, the surges of the sea, for some few days, beat them back upon the shore. Thus exposed, they remain a prey to thousands of birds that haunt the coasts at that period; and these stooping down upon them, carry off the greatest part, and sometimes the whole brood, before they have strength sufficient to withstand the waves, or dive to the bottom. Helbigius informs us, that they have still another enemy to fear, which is no other than the parent that produced them, that waits for their arrival at the edge of the deep, and devours as many as she can. This circumstance, however, demands further confirmation; though nothing is more certain than that the crocodile acts in the same unnatural manner.

When the turtles have done laying, they then return to their accustomed places of feeding. Upon their outset to the shore, where they breed, they are always observed to be fat and healthy; but, upon their return, they are weak, lean, and unfit to be eaten. They are seldom, therefore, molested upon their retreat; but the great art is to seize them when arrived, or to intercept their arrival. In these uninhabited islands, to which the green turtle chiefly resorts, the men that go to take them land about night-fall, and without making any noise, (for those animals, though without any external opening of the ear, hear very distinctly, there being an auditory conduit that opens into the mouth,) lie close while they see the female turtle coming on shore. They let her proceed to her greatest distance from the sea; and then, when she is most busily employed in scratching a hole in the sand, they sally out and surprise her. Their manner is to turn her upon her back, which totally incapacitates her from moving; and yet, as the creature is very strong, and struggles very hard, two men find it no easy matter to lay her over. When thus secured they go to the next; and in this manner, in less than three hours, they have been known to turn forty or fifty turtles, each of which weighs from a hundred and fifty to two hundred pounds. Labat assures us, that when the animal is in this helpless situation, it is heard to sigh very heavily, and is even observed to shed tears.

At present, from the great appetite that man has discovered for this animal, they are not only thinned in their numbers, but are also grown much more shy. There are several other ways, therefore, contrived for taking them. One is, to seize them at the breeding season, when they are very easily approached, and as easily seen; for these animals, though capable of living for some time under water, yet rise every eight or ten minutes to breathe. As soon as they are thus perceived, two or three people draw near them in a canoe, and slip a noose either round their necks or one of their feet. If they have no line, they lay hold of them by the neck, where they have no shell, with their hands only; and by this means they usually catch them both. But sometimes the female escapes, being more shy than the male.

Another way of taking them is by the harpoon, either when they are playing on the surface of the water, or feeding at the bottom; when the harpoon is skilfully darted, it sticks fast in the shell of the back; the wood then disengages from the iron, and the line is long enough for the animal to take its range; for if the harpooner should attempt at once to draw the animal into his boat till it is weakened by its own struggling, it would probably get free. Thus the turtle struggles hard to get loose, but its efforts are in vain; for they take care the line fastened to the harpoon shall be strong enough to hold it.

There is yet another way which, though seemingly awkward, is said to be attended with very great success. A good diver places himself at the head of the boat; and when the turtles are observed, which they sometimes are in great numbers, asleep on the surface, he immediately quits the vessel, at about fifty yards distance, and keeping still under water, directs his passage to where the turtle was seen, and coming up beneath, seizes it by the tail; the animal awaking, struggles to get free; and by this both are kept at the surface until the boat arrives to take them in.

OF THE SHELL OF TESTACEOUS FISHES.

One is apt to combine very dissimilar objects in the same group, when hurried into the vortex of method. No two animals are more unlike each other than the whale and the limpet, the tortoise and the oyster. Yet, as these animals must find some place in the picture of Animated Nature, it is best to let them rest in the station where the generality of mankind have assigned them; and as they have been willing to give them all from their abode the name of fishes, it is wisest in us to conform to the general custom.

But before we enter into any history of shell-fish, it may not be improper to observe, that naturalists who have treated on this part of history, have entirely attended to outward forms; and, as in many other instances, forsaking the description of the animal itself, have exhausted all their industry in describing the habitation. In consequence of this radical error, volumes have been written upon the subject of shells, and very little said on the history of shell-fish. The life of these industrious creatures, that for the most part creep along the bottom, or immoveably wait till driven as the waves happen to direct, is almost entirely unknown. The wreathing of their shells, or the spots with which they are tinctured, have been described with a most disgusting prolixity; but their appetites and their combats, their escapes and humble arts of subsistence, have been utterly neglected.

As I have only undertaken to write the history of Animated Nature, the variety of shells, and their peculiar spots or blemishes, do not come within my province. However, the manner in which shells are formed, is a part of natural history connected with my plan, since it pre-supposes vital force or industry in the animal that forms them.

The shell may be considered as a habitation supplied by Nature. It is a hard stony substance, made up somewhat in the manner of a wall. Part of the stony substance the animal derives from outward objects, and the fluids of the animal itself furnish the cement. These united make that firm covering which shell-fish generally reside in till they die.

But in order to give a more exact idea of the manner in which sea-shells are formed, we must have recourse to an animal that lives upon land, with the formation of whose shell we are best acquainted. This is the garden-snail, that carries its box upon its back, whose history Swammerdam has taken such endless pains to describe. As the manner of the formation of this animal's shell extends to that of all others that have shells, whether they live upon land or in the water, it will be proper to give it a place before we enter upon the history of testaceous fishes.

To begin with the animal in its earliest state, and trace the progress of its shell from the time it first appears:—The instant the young snail leaves the egg, it carries its shell, or its box, on its back. It does not leave the egg till it is arrived at a certain growth, when its little habitation is sufficiently hardened. This beginning of the shell is not much bigger than a pin's head, but grows in a very rapid manner, having at first but two circumvolutions, for the rest are added as the snail grows larger. In proportion as the animal increases in size, the circumvolutions of the shell increase also, until the number of those volutes come to be five, which is never exceeded.

The part where the animal enlarges its shells is at the mouth, to which it adds in proportion as it finds itself stinted in its habitation below. Being about to enlarge its shell, it is observed with its little teeth biting and clearing away the scaly skin that grows at the edges.

It is sometimes seen to eat those bits it thus takes off; at other times it only cleans away the margin when covered with films, and then adds another rim to its shell.

For the purposes of making the shell, which is natural to the animal, and without which it could not live three days, its whole body is furnished with glands, from the orifices of which flows out a kind of slimy fluid, like small spiders' threads, which join together in one common crust or surface, and in time condense and acquire a stony hardness. It is this slimy humour that grows into a membrane, and afterwards a stony skin; nor can it have escaped any who have observed the track of a snail, that glistening substance which it leaves on the floor or the wall, is no other than the materials with which the animal adds to its shell, or repairs it when broken.

Now, to exhibit in a more satisfactory manner the method in which the shell is formed.—The snail bursts from its egg with its shell upon its back; this shell, though very simple, is the centre round which every succeeding convolution of the shell is formed, by new circles added to the first. As the body of the snail can be extended no where but to the aperture, the mouth of the shell only can, of consequence, receive augmentation. The substance of which the shell is composed is chiefly supplied by the animal itself, and is no more than a slimy fluid which hardens into bone. This fluid passes through an infinite number of little glands till it arrives at the pores of the skin; but there it is stopped by the shell that covers the part below; and therefore is dispatched to the mouth of the shell, where it is wanted for its enlargement. There the first layer of slime soon hardens; and then another is added, which hardens also, till, in time, the shell becomes as thick as is requisite for the animal's preservation. Thus every shell may be considered as composed of a number of layers of slime, which have entirely proceeded from the animal's own body.

But though this be the general opinion with regard to the formation of shells, I cannot avoid thinking there are still other substances besides the animal's own slime which go to the composition of its shell, or at least to its external coat, which is ever different from the internal. The substances I mean are the accidental concretions of earthy or saline particles, which adhere to the slimy matter upon its first emission. By adopting this theory, we can more satisfactorily account for the various colours of the shell, which cannot be supposed to take its tincture from the animal's body, as is the usual opinion; for all the internal parts of the shell are but of one white colour; it is only the outermost layer of the shell that is so beautifully varied, so richly tinctured with that variety of colours we behold in the cabinets of the curious. If the external coat be scaled off, as Mr. Angenville asserts, all the inner substance will be perceived but of one simple colouring; and consequently the animal's own juices can give only one colour; whereas we see some shells stained with a hundred.

The usual way of accounting for the different colouring of shells, which seems to me erroneous, is this: in the body of every one of these animals, several streaks are discerned of a different colour from the rest. 'This variety,' say they, 'is an incontestible proof that the juices flowing from those parts will be also of a different hue; and will consequently tinge that part of the shell which their slime composes of a different colour.' But this system, as was observed before, is completely overthrown by the fact, which discovers that only the outer surface of the shell is tinged; whereas by this it would have been coloured throughout; nay, by this system, the internal parts of the shell would be stained with the most vivid colouring, as being least exposed to the external injuries of the element where it is placed. But the truth is, the animal residing in the shell has none of these various colours thus talked of: its slime is a simple, pellucid substance; and the only marblings which appear in its body, are the colour of the food which is seen through its transparent intestines. We must, therefore, account for the various colouring of its shell upon a different principle.

If, as I said, we examine the cabinets of the curious, we shall find shells with various and beautiful colouring; we shall find them generally furnished with a white ground, tinctured with red, yellow, brown, green, and several other shades and lovely mixtures, but never blue. Shells are of almost all colours but blue. The reason seems to be obvious; for blue is the colour which sea-water changes. A piece of silk, or a feather, of this colour, put into an infusion of salt, urine, or nitre, lose their tint entirely. Now, may not this give us a hint with respect to the operation of Nature in colouring her shells? May we not from hence likewise conclude, that sea-water is efficacious in giving colour or taking it away? That, to produce colour, the animal not only furnishes its juices, but the sea or the earth that mixture of substance which is necessary to unite with them. Neither the animal slime alone, nor the external earthy or saline substances alone, could produce colours; but both united, produce an effect which neither separately were possessed of. Thus shells assume every colour but blue; and that sea water, instead of producing, would be apt to destroy.

From hence, therefore, it will appear, that the animal does not alone tincture its own shell; but that external causes co-operate in contributing to its beauty. It is probable, that, from the nature of its food, or from other circumstances unknown to us, the external layers of its slime may be of different consistences; so as, when joined with the particles of earth or salt that are accidentally united with them from without, they assume various and beautiful hues. But the internal layers, which receive no foreign admixture, still preserve the natural colour of the animal, and continue white without any variation.

Thus far we perceive that the animal is not wholly the agent in giving beauty and colouring to its shell: but it seems otherwise with respect to its convolutions, its prominences, and general form. These entirely depend upon the art of the animal; or rather upon its instincts; which, in the same kinds, are ever invariable. The shell generally bears some rude resemblance to the body upon which it has been moulded. Thus, it is observable in all sea-shells, that if the animal has any tumour or excrescence on its body, it creates likewise a swelling in that part of the incrustation to which it corresponds. When the animal begins to alter its position, and to make new additions to its apartments, the same protuberance which had raised the shell before in one part, swells it again at some little distance; by which means we see the same inequality, in a spiral line, all round the shell. Sometimes, indeed, these tumours of the animal are so large, or so pointed, that those which rise over them in the incrustation, appear like horns: after this the animal disengages itself from its first cavities, and then, by fresh evacuations, assumes a new set of horns; and so increases the number in proportion to its growth. If, on the other hand, the body happens to be channelled, the shell that covers it will be channelled likewise; if there be any protuberances in the body, which wind in a spiral line about it, the shell will likewise have its tumours and cavities winding round to the end.

In this manner as the animals are of various forms, the shells exhibit an equal variety. Indeed, the diversity is so great, and the figures and colours so very striking, that several persons, with a kind of harmless indolence, have made the arrangement of them the study and the business of their lives. Those who consult their beauty alone, take care to have them polished, and to have an external crust, or periosteum, as Swammerdam calls it, scoured off from their surfaces by spirit of salt. But there are others that, with more learned affectation, always keep them exactly in the state in which they have been found, with their precious crust still round them. The expense men have sometimes been at in making such collections, is amazing; and some shells, such as the stairs-shell, or the admiral-shell, are not more precious for their scarceness, than pearls are for their beauty. Indeed, it is the scarcity, and not the beauty of the object, that determines the value of all natural curiosities. Those shells that offer but little beauty to the ignorant, are often the most precious; and those shells which an unlearned spectator would stop to observe with admiration, one accustomed to the visitation of cabinets, would pass over with disdain.—These collections, however, have their use; not only by exhibiting the vast variety of the operations of Nature, but also by exciting our curiosity to the consideration of the animals that form them. A mind that can find innocent entertainment in these humble contemplations is well employed; and, as we say of children, is kept from doing mischief. Although there may be nobler occupations than that of considering the convolutions of a shell, yet there may be some who want the ambition to aspire after such arduous pursuits; there may be some unfit for them; there may be some who find their ambition fully gratified by the praise which the collectors of shells bestow upon each other. Indeed, for a day or two, there is no mind that a cabinet of shells cannot furnish with pleasing employment. 'What can be more gratifying,' as Pliny says, 'than to view Nature in all her irregularities, and sporting in her variety of shells! Such a difference of colour do they exhibit! such a difference of figure! flat, concave, long, lunated, drawn round in a circle, the orbit cut in two! some are seen with a rising on the back, some smooth, some wrinkled, toothed, streaked, the point variously intorted, the mouth pointing like a dagger, folded back, bent inwards! all these variations, and many more, furnish at once novelty, elegance, and speculation.'

With respect to the figure of shells, Aristotle has divided them into three kinds; and his method is, of all others, the most conformable to Nature. These are, first, the *univalve*, or *turbinated*, which consist of one piece, like the box of a snail; secondly, the *bivalve*, consisting of two pieces, united by a hinge, like an oyster; and, thirdly, the *multivalve*, consisting of more than two pieces, as the acorn-shell, which has not less than twelve pieces that go to its composition. All these kinds are found in the sea at different depths, and are valuable in proportion to their scarceness or beauty.

From the variety of the colours and figure of shells, we may pass to that of their place and situation. Some are found in the sea, some in fresh-water rivers; some alive upon land; and a still greater quantity dead in the bowels of the earth. But wherever shells are discovered, they are universally known to be composed of one and the same substance. They are formed of an animal or calcarious earth, that ferments with vinegar and other acids, and that burns into lime, but will not easily melt into glass. Such is the substance of which they are composed; and of their spoils, many philosophers think that a great part of the surface of the earth is composed at present. It is supposed by them, that chalks, marls, and all such earths as ferment with vinegar, are nothing more than a composition of shells, decayed, and crumbled down to one uniform mass.

Sea-shells are either found in the depths of the ocean, or they are cast empty and forsaken of their animals upon shore. Those which are fished up from the deep, are called by the Latin name *Pelagii;* those that are cast upon shore, are called *Littorales.* Many of the pelagii are never seen upon shore; they continue in the depths where they are bred; and we owe their capture only to accident. These, therefore, are the most scarce shells, and consequently the most valuable. The littorales are more frequent, and such as are of the same kind with the pelagii are not so beautiful. As they are often empty and forsaken, and as their animal is dead, and perhaps putrid in the bottom of the shell, they by this means lose the whiteness and the brilliancy of their colouring. They are not unfrequently also found eaten through, either by worms or by each other; and they are thus rendered less valuable: but that which decreases their price still more is, when they are scaled and worn by lying too long empty at the bottom, or exposed upon the shore. Upon the whole, however, sea-shells exceed either land or fossil shells in beauty; they receive the highest polish, and exhibit the most brilliant and various colouring.

Fresh water shells are neither so numerous, so various, nor so beautiful as those belonging to the sea. They want that solidity which the others have; their *clavicle,* as it is called, is neither so prominent nor so strong; and not having a saline substance to tinge the surface of the shell, the colours are obscure. In fresh water there are but two kinds of shells, namely, the bivalved and the turbinated.

Living land-shells are more beautiful, though not so various as those of fresh water; and some not inferior to sea-shells in beauty. They are, indeed, but of one kind, namely, the turbinated; but in that there are found four or five very beautiful varieties.

Of fossil, or, as they are called, *extraneous* shells, found in the bowels of the earth, there are great numbers, and as great a variety. In this class there are as many kinds as in the sea itself. There are found there turbinated, the bivalve, and the multivalve kinds; and of all these, many at present not to be found even in the ocean. Indeed, the number is so great, and the varieties so many, that it was long the opinion of naturalists, that they were merely the capricious productions of Nature, and had never given retreat to animals whose habitations they resembled. They were found, not only of various kinds, but in different states of preservation: some had the shell entire, composed, as in its primitive state, of a white calcarious earth, and filled with earth, or even empty; others were found with the shell entire, but filled with a substance which was petrified by time; others, and these in great numbers, were found with the shell entirely mouldered away, but the petrified substance that filled it still exhibiting the figure of the shell; others still, that had been lodged near earth or stone, impressed their print upon these substances, and left the impression, though they themselves were decayed: lastly, some shells were found half mouldered away, their parts scaling off from each other in the same order in which they were originally formed. But these different stages of the shell, and even their fermenting with acids, were at first insufficient to convince those who had before assigned them a different origin. They were still considered as accidentally and sportively formed, and deposited in the various repositories where they were found, but no way appertaining to any part of Animated Nature. This put succeeding inquirers upon more minute researches; and they soon began to find, that often where they dug up petrified shells or teeth, they could discover the petrified remains of some other bony parts of the body. They found that the shells which were taken from the earth, exhibited the usual defects and mischances, which the same kind are known to receive at sea. They showed them not only tinctured with a salt-water crust, but pierced in a peculiar manner by the sea-worms, that make the shells of fishes their favourite food. These demonstrations were sufficient at last to convince all but a few philosophers who died away, and whose erroneous systems died with them.

Every shell, therefore, wherever it is found, is now considered as the spoil of some animal, that once found shelter therein. It matters not by what unaccountable means they may have wandered from the sea; but they exhibit all, and the most certain marks of their origin. From their numbers and situation, we are led to conjecture, that the sea once reached the places where they are found; and from their varieties, we learn how little we know of all the sea contains at present; as the earth furnishes many kinds which our most exact and industrious shell-collectors have not been able to fish up from the deep. It is most probable that thousands of different forms still remain at the bottom unknown; so that we may justly say with the philosopher: *Ea quæ scimus sunt pars minima eorum quæ ignoramus.*

But it is well for mankind, that the defect of our knowledge on this subject is, of all parts of learning, that which may be most easily dispensed with. An increase in the number of shells, would throw but very few lights upon the history of the animals that inhabit them. For such information we are obliged to those men who contemplated something more than the outside of the objects before them. To Reaumur we are obliged for examining the manners of some with accuracy; but to Swammerdam for more. In fact, this Dutch author has given so much attention to those animals, that it almost exceeds credibility: he has excelled even the insects he dissected, in patience, industry, and perseverance. It was in vain that this poor man's father dissuaded him from what the world considered as a barren pursuit; it was in vain that an habitual disorder, brought on by his application, interrupted his efforts; it was in vain that mankind treated him with ridicule while living, as they suffered his works to remain long unprinted and neglected when dead; still the Dutch philosopher went on, peeping into unwholesome ditches, wading through fens, dissecting spiders, and enumerating the blood-vessels of a snail: like the bee, whose heart he could not only distinguish, but dissect, he seemed instinctively impelled by his ruling passion, although he found nothing but ingratitude from man, and though his industry was apparently becoming fatal to himself. From him I will take some of the leading features in the history of those animals which breed in shells; previously taking my division from Aristotle, who, as was said above, divides them into three classes: the Turbinated, or those of the Snail kind; the Bivalved, or those of the Oyster kind; and the Multivalved, or those of the Acorn-shell kind.

OF TURBINATED SHELL-FISH OF THE SNAIL KIND.

To conceive the manner in which those animals subsist that are hid from us at the bottom of the deep, we must again have recourse to one of a similar nature and formation, that we know. The history of the garden-snail has been more copiously considered than that of the elephant; and its anatomy is as well, if not better known: however, not to give any one object more room in the general picture of Nature than it is entitled to, it will be sufficient to observe, that the snail is surprisingly fitted for the life it is formed to lead. It is furnished with the organs of life in a manner almost as complete as the largest animal; with a tongue, brain, salival ducts, glands, nerves, stomach, and intestines; liver, heart, and blood-vessels: besides this, it has a purple bag that furnishes a red matter to different parts of the body, together with strong muscles that hold it to the shell, and which are hardened, like tendons, at their insertion.

But these it possesses in common with other animals. We must now see what it has peculiar to itself. The first striking peculiarity is, that the animal has got its eyes on the points of its largest horns. When the snail is in motion, four horns are distinctly seen; but the two uppermost and longest deserve peculiar consideration, both on account of the various motions with which they are endued, as well as their having their eyes fixed at the extreme ends of them. These appear like two blackish points at their extremities. When considered as taken out of the body, they are of a bulbous or turnip-like figure; they have but one coat; and the three humours which are common in the eyes of other animals, namely, the vitreous, the aqueous, and the crystalline, are in these very indistinctly seen. The eyes the animal can direct to different objects at pleasure, by a regular motion out of the body; and sometimes it hides them, by a very swift contraction into the belly. Under the small horns is the animal's mouth; and though it may appear too soft a substance to be furnished with teeth, yet it has not less than eight of them, with which it devours leaves, and other substances, seemingly harder than itself; and with which it sometimes bites off pieces of its own shell.

At the expiration of eighteen days, after snails make love, they produce their eggs, at the opening of the neck and hide them in the earth with the greatest solicitude and industry. These eggs are in great numbers, round, white, and covered with a soft shell: they are also stuck to each other by an imperceptible slime, like a bunch of grapes, of about the size of a small pea.

When the animal leaves the egg, it is seen with a very small shell on its back, which has but one convolution; but in proportion as it grows, the shell increases in the number of its circles. The shell always receives its additions at the mouth; the first centre still remaining: the animal sending forth from its body that slime which hardens into a stony substance, and still is fashioned into similar volutions. The garden-snail seldom exceeds four rounds and a half; but some of the sea-snails arrive even at ten.

The snail, thus fitted with its box, which is light and firm, finds itself defended in a very ample manner from all external injury. Whenever it is invaded, it is but retiring into this fortress, and waiting patiently till the danger is over. Nor is it possessed only of a power of retreating into its shell, but of mending it when broken. Sometimes these animals are crushed seemingly to pieces; and, to all appearance, utterly destroyed: yet still they set themselves to work, and, in a few days, mend all their numerous breaches. The same substance by which the shell is originally made, contributes to the re-establishment of the ruined habitation. But all the junctures are easily seen, for they have a fresher colour than the rest, and the whole shell in some measure resembles an old coat, patched with new pieces. They are sometimes seen with eight or ten of these patches; so that the damage must have been apparently irreparable. Still, however, though the animal is possessed of the power of mending its shell, it cannot, when come to its full growth, make a new one. Swammerdam tried the experiment: he stripped a snail of its shell, without hurting any of the blood-vessels, retaining that part of the shell where the muscles were inserted; but it died in three days after it was stripped of its covering: not, however, without making efforts to build up a new shell; for, previous to its death, it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature, and was intended, by the animal, as a supply towards a new one.

As the snail is furnished with all the organs of life and sensation, it is not wonderful to see it very voracious. It chiefly subsists upon the leaves of plants and trees; but is extremely delicate in its choice. When the animal moves to seek its food, it goes forward by means of that broad muscular skin which is sometimes seen projecting round the mouth of the shell; this is expanded before, and then contracted with a kind of undulating motion, like a man attempting to move himself forward by one arm, while lying on his belly. But the snail has another advantage, by which it not only smooths and planes its way, but also can ascend in the most perpendicular direction. This is by that slimy substance with which it is so copiously furnished, and which it emits wherever it moves. Upon this slime, as upon a kind of carpet, it proceeds slowly along, without any danger of wounding its tender body against the asperities of the pavement; by means of this it moves upwards to its food upon trees; and by this descends without danger of falling, and breaking its shell by the shock.

The appetite of these animals is very great; and the damage gardeners in particular sustain from them, makes them employ every method for their destruction. Salt will destroy them, as well as soot; but a tortoise in a garden is said to banish them much more effectually.

At the approach of winter, the snail buries itself in the earth; or retires to some hole, to continue in a torpid state, during the severity of the season. It is sometimes seen alone, but more frequently in company when it retreats; several being usually found together, apparently deprived of life and sensation. For the purposes of continuing in greater warmth and security, the snail forms a cover or lid to the mouth of its shell with its slime, which stops it up entirely, and thus protects it from every external danger. The matter of which the cover is composed, is whitish, somewhat like plaster, pretty hard and solid, yet at the same time porous and thin, to admit air, which the animal cannot live without. When the cover is formed too thick, the snail then breaks a little hole in it, which corrects the defect of that closeness, which proceeded from too much caution. In this manner, sheltered in its hole from the weather, defended in its shell by a cover, it sleeps during the winter; and, for six or seven months, continues without food or motion, until the genial call of spring breaks its slumber, and excites its activity.

The snail, having slept for so long a season, wakes one of the first fine days of April, breaks open its cell, and sallies forth to seek for nourishment. It is not surprising that so long a fast should have thinned it, and rendered it exceedingly voracious. At first, therefore, it is not very difficult in the choice of its food; almost any vegetable that is green seems welcome; but the succulent plants of the garden are chiefly grateful; and the various kinds of pulse are, at some seasons, almost wholly destroyed by their extraordinary numbers. So great is the multiplication of snails at some years, that gardeners imagine they burst from the earth. A wet season is generally favourable to their production; for this animal cannot bear very dry seasons, or dry places, as they cause too great a consumption of its slime, without which it cannot subsist in health and vigour.

Such are the most striking particulars in the history of this animal; and this may serve as a general picture, to which the manners and habitudes of the other tribes of this class may be compared and referred. These are, the sea snail, of which naturalists have, from the apparent difference of their shells, noticed fifteen kinds, as mentioned in D'Argenville's Conchyliologie; the fresh water snail, of which there are eight kinds; and the land snail, of which there are five. These all bear a strong resemblance to the garden snail, in the formation of their shell, in their hermaphrodite natures, in the slimy substance with which they are covered, in the formation of their intestines, and the disposition of the hole on the right side of the neck, which serves at once for the discharge of the fæces, for respiration, when the animal is under the necessity of taking in a new supply, and for other purposes.

But in Nature, no two kinds of animals, however like each other in figure or conformation, are of manners entirely the same. Though the common garden snail bears a very strong resemblance to that of fresh water, and that of the sea, yet there are differences to be found, and those very considerable ones.

If we compare them with the fresh water snail, though we shall find a general resemblance, yet there are one or two remarkable distinctions: and, first, the fresh water snail, and, as I should suppose, all snails that live in water, are peculiarly furnished with a contrivance by Nature, for rising to the surface, or sinking to the bottom. The manner in which this is performed, is by opening and shutting the orifice on the right side of the neck, which is furnished with muscles for that purpose The snail sometimes gathers this aperture into an oblong tube, and stretches or protends it above the surface of the water, in order to draw in or expel the air as it finds occasion. This may not only be perceived, but heard also by the noise which the snail makes in moving the water. By dilating this it rises, by compressing it the animal sinks to the bottom. This is effected somewhat in the manner in which little images of glass are made to rise or sink in water, by pressing the air contained at the mouth of the tubes, so that it shall drive the water into their hollow bodies, which before were filled only with air, and thus make them heavier than the element in which they swim. In this manner does the fresh water snail dive or swim, by properly managing the air contained in its body.

But what renders these animals far more worthy of notice is, that they are viviparous, and bring forth their young not only alive, but with their shells upon their backs. This seems surprising; yet it is incontestibly true! the young arrive at some degree of perfection in the womb of the parent; there they receive their stony coat; and from thence are excluded, with a complete apparatus for subsistence.

'On the twelfth of March,' says Swammerdam, 'I began my observations upon this snail, and collected a great number of the kind, which I put into a large basin filled with rain water, and fed for a long time with potter's earth, dissolved in the water about them. On the thirteenth of the same month I opened one of these snails, when I found nine living snails in its womb: the largest of these were placed foremost, as the first candidates for exclusion. I put them into fresh water, and they lived till the eighteenth of the same month, moving and swimming, like snails full grown; nay, their manner of swimming was much more beautiful.' Thus, at whatever time of the year these snails are opened, they are found pregnant with eggs, or with living snails; or with both together.

This striking difference between the fresh water and the garden snail, obtains also in some of the sea kind; among which there are some that are found viviparous, while others lay eggs in the usual manner. Of this kind are one or two of the buccinums; within which living young have been frequently found, upon their dissection. In general, however, the rest of this numerous class bring forth eggs; from whence the animal bursts at a proper state of maturity, completely equipped with a house, which the moistness of the element where it resides does not prevent the inhabitant from enlarging. How the soft slime of the snail hardens, at the bottom of the sea, into the stony substance of a shell, is not easy to conceive! This slime must at least be possessed of very powerful petrifying powers.

All animals of the snail kind, as was observed before, are hermaphrodites; but some of the sea kinds act differently from those of the garden.

There is a considerable difference between land and sea snails. Many of the latter entirely want horns; and none of them have above two. Indeed, if the horns of snails be furnished with eyes, and if, as some are willing to think, the length of the horn, like the tube of a telescope, assists vision, these animals that chiefly reside in the gloomy bottom of the deep, can have no great occasion for them. Eyes would be unnecessary to creatures whose food is usually concealed in the darkest places; and who, possessed of very little motion, are obliged to search minutely for what they subsist on. To such, I say, eyes would rather be an obstruction than an advantage; and, perhaps, even those that live upon land are without them.

Those that have seen the shells of sea snails, need not be told, that the animal which produces them is larger than those of the same denomination upon land. The sea seems to have the property of enlarging the magnitude of all its inhabitants; and the same proportion that a trout bears to a shark, is often seen to obtain between a shell bred upon the land, and one bred in the ocean. Its convolutions are more numerous. The garden snail has but five turns at the most; in the sea snail the convolutions are sometimes seen amounting to ten.

There is a difference likewise in the position of the mouth, in the garden and the water snail. In the former, the mouth is placed crosswise, as in quadrupeds; furnished with jaw-bones, lips, and teeth. In most of the sea snails, the mouth is placed longitudinally in the head; and in some obliquely, or on one side. Others, of the trochus kind, have no mouth whatsoever; but are furnished with a trunk, very long in some kinds, and shorter in others.

Snails of the trochus kind, furnished thus with an instrument of offence, deserve our particular attention. The trunk of the trochus is fleshy, muscular, supple, and hollow. Its extremity is bordered with a cartilage, and toothed like a saw. The snails that are provided with this, may be considered as the predacious tribe among their fellows of the bottom. They are among snails, what the tiger, the eagle, or the shark is among beasts, birds, or fishes. The whole race of shelled animals avoid their approach; for their habitations, however powerfully and strongly built, though ever so well fortified, yield to the superior force of these invaders. Though provided with a thick, clumsy shell themselves, yet they move with greater swiftness at the bottom than most other shell fish, and seize their prey with greater facility. There is no shell so large but they will boldly venture to attack it; and, with their piercing augre-like trunk, will quickly bore it through. No efforts the other animal makes can avail: it expands itself, and rises to the surface: but the enemy rises with it: it again sinks to the bottom, but still its destroyer closely adheres. In this manner the carnivorous shell-fish, as some naturalists call it, sticks for several days, nay weeks, to its prey, until, with its trunk, it has sucked out all substance, or until it drops off when the other begins to putrefy.

Thus it would seem throughout Nature, that no animal is so well defended, but that others are found capable of breaking in upon its entrenchments. The garden snail seems tolerably well guarded; but the wall of its shell is paper itself, in comparison with that which fortifies some of the sea snail kind. Beside this thick shell, many of them are also furnished with a lid, which covers the mouth of the shell, and which opens and shuts at the pleasure of the animal. When the creature hunts for food, it opens its box, gropes or swims about; and, when satisfied, drops its lid, and sinks to the bottom: there it might be supposed to remain in perfect security; but the trochus soon finds the way to break into the thickest part of its inclosure, and quickly destroys it with the most fatal industry.

The being liable to the attacks of the trochus seems to be a calamity to which most of this tribe are subject. Scarcely a shell is met with entire and sound to the end of its convolutions; but particularly the thinnest shells are the most subject to be thus invaded. As their shells are easily pierced, the predatory shell-fish, or the sea-worm, chiefly seek them for subsistence; and of those thin, paper-like shells, not one in a hundred is found that has not suffered some disaster. As they are lighter than other shell-fish, they swim with greater ease; and this is the chief method of avoiding their heavier thick shelled pursuers. The food of all snails properly lies at the bottom; when, therefore, the nautilus or other thin shelled fish are seen busily swimming at the surface, it may be, that instead of sporting or sunning themselves, as some are apt to suppose, they are actually labouring to escape their most deadly pursuers.

Of all sea-snails, that which is most frequently perceived swimming upon the surface, and whose shell is the thinnest and most easily pierced, is the nautilus. Whether upon these occasions, it is employed in escaping its numerous enemies at the bottom, or seeking for food at the surface, we shall not venture to decide. It seems most probable, that the former is the cause of its frequently appearing; for, upon opening the stomach, it is found to contain chiefly that food which it finds at the bottom. This animal's industry, therefore, may be owing to its fears: and all those arts of sailing which it has taught mankind, may have been originally the product of necessity. But the nautilus is too famous not to demand a more ample description. Although there be several species of the nautilus, yet they all may be divided into two: the one with a white shell, as thin as paper, which it is often seen to quit, and again to resume; the other with a thicker shell, sometimes of a beautiful mother-of-pearl colour, and that quits its shell but rarely. This shell outwardly resembles that of a large snail, but is generally six or eight inches across: within it is divided into forty partitions, that communicate with each other by doors, if we may so call them, through which one could not thrust a goose-quill: almost the whole internal part of the shell is filled by the animal; the body of which, like its habitation, is divided into as many parts as there are chambers in its shell: all the parts of its body communicate with each other, through the doors or openings, by a long blood vessel, which runs from the head to the tail: thus the body of the animal, if taken out of the shell, may be likened to a number of soft bits of flesh, of which there are forty threaded upon a string. From this extraordinary conformation, one would not be apt to suppose that the nautilus sometimes quitted its shell, and returned to it again; yet nothing, though seemingly more impossible, is more certain. The manner by which it contrives to disengage every part of its body from so intricate a habitation; by which it makes a substance to appearance as thick as one's wrist, pass through forty doors, each of which would scarcely admit a goose-quill, is not yet discovered; but the fact is certain; for the animal is often found without its shell; and the shell more frequently destitute of the animal. It is most probable, therefore, that it has a power of making the substance of one section of its body remove up into that which is next; and thus, by multiplied removals it gets free.

But this, though very strange, is not the peculiarity for which the nautilus has been the most distinguished. Its " spreading the thin oar," and " catching the flying gale," to use the poet's description of it, has chiefly excited human curiosity. These animals, particularly those of the white, light kind, are chiefly found in the Mediterranean; and scarcely any one who have sailed on that sea, but must often have seen them. When the sea is calm, they are observed floating on the surface; some spreading their little sail; some rowing with their feet, as if for life and death; and others still, floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with eight feet, which issue near the mouth, and may as properly be called barbs: these are connected to each other by a thin skin, like that between the toes of a duck, but much thinner and more transparent. Of these eight feet thus connected, six are short, and these are held up as sails to catch the wind in sailing: the two others are longer, and are kept in the water; serving, like paddles, to steer their course by. When the weather is calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest; but whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and instantly sinks to the bottom. Sometimes, also, it is seen pumping the water from its leaking hulk; and, when unfit for sailing, deserts its shell entirely. The forsaken hulk is seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.

From the above description, we may consider this animal rather as attempting to save itself from the attacks of its destroyers, than as rowing in pursuit of food. Certain it is, that no creature of the deep has more numerous and more powerful enemies. Its shell is scarcely ever found in perfect preservation; but is generally seen to bear some marks of hostile invasion. Its little arts, therefore, upon the surface of the water, may have been given it for protection; and it may thus be endued with comparative swiftness to avoid the crab, the sea-scorpion, the trochus, and all the slower predacious reptiles that lurk for it at the bottom of the water.

From this general view of snails, they appear to be a much more active, animated tribe, than from their figure one would at first conceive. They seem to an inattentive spectator, as mere inert masses of soft flesh, rather loaded than covered with a shell, scarcely capable of motion, and insensible to all the objects around them. When viewed more closely, they are found to be furnished with the organs of life and sensation in a tolerable degree of perfection: they are defended with armour, that is at once both light and strong; they are as active as their necessities require; and are possessed of appetites more poignant than those of animals that seem much more perfectly formed. In short, they are a fruitful, industrious tribe; furnished, like all other animals, with the powers of escape and invasion; they have their pursuits and their enmities; and, of all creatures of the deep, they have most to fear from each other.

OF BIVALVED SHELL-FISH, OR SHELLS OF THE OYSTER KIND.

It may seem whimsical to make a distinction between the animal perfections of turbinated and bivalved shell-fish; or to grant a degree of superiority to the snail above the oyster. Yet this distinction strongly and apparently obtains in Nature; and we shall find the bivalved tribe of animals in every respect inferior to those we have been describing. Inferior in all their sensations; inferior in their powers of motion; but peculiarly inferior in some other particulars. The snail tribe, as we saw, are hermaphrodite, but require the assistance of each other for fecundation; all the bivalve tribe are hermaphrodite in like manner, but they require no assistance from each other towards impregnation; and a single muscle or oyster, if there were no other in the world, would quickly replenish the ocean. As the land snail, from its being best known, took the lead in the former class, so the fresh water muscle, for the same reason, may take the lead in this. The life and manners of such as belong to the sea will be best displayed in the comparison.

The muscle, as is well known, whether belonging to fresh or salt water, consists of two equal shells, joined at the back by a strong muscular ligament, that answers all the purposes of a hinge. By the elastic contraction of these the animal can open its shell at pleasure, about a quarter of an inch from each other. The fish is fixed to either shell by four tendons, by means of which it shuts them close, and keeps its body firm from being crushed by any shock against the walls of its own habitation. It is furnished, like all other animals of this kind, with vital organs, though these are situated in a very extraordinary manner. It has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and makes a number of circumvolutions through the liver; on leaving this organ, it goes on straight into the heart, which it penetrates, and ends in the anus; near which the lungs are placed, and through which it breathes, like those of the snail kind; and in this manner its languid circulation is carried on.

As the muscle is furnished with a kind of self-creating power, there are few places where it breeds, that it is not found in great abundance. The ovaries usually empty themselves of their eggs in spring, and they are replenished in autumn. For this reason they are found empty in summer and full in winter. They produce in great numbers, as all bivalved shell-fish are found to do. The fecundity of the snail kind is trifling in comparison to the fertility of these. Indeed it may be asserted as a general rule in Nature, that the more helpless and contemptible the animal, the more prolific it is always found. Thus all creatures that are incapable of resisting their destroyers, have nothing but their quick multiplication for the continuation of their existence.

The multitude of these animals in some places is exceedingly great; but, from their defenceless state, the number of their destroyers are in equal proportion. The crab, the cray-fish, and many other animals, are seen to devour them; but the trochus is their most formidable enemy. When their shells are found deserted, if we then observe closely, it is most probable we shall find that the trochus has been at work in piercing them. There is scarcely one of them without a hole in it; and this probably was the avenue by which the enemy entered to destroy the inhabitant.

But notwithstanding the number of this creature's animated enemies, it seems still more fearful of the agitations of the element in which it resides; for if dashed against rocks, or thrown far on the beach, it is destroyed without a power of redress. In order to guard against these, which are to this animal the commonest and the most fatal accidents, although it has a power of slow motion, which we shall presently describe, yet it endeavours to become stationary, and to attach itself to any fixed object it happens to be near. For this purpose, it is furnished with a very singular capacity of binding itself by a number of threads to whatever object it approaches; and these Reaumur supposed it spun artificially, as spiders their webs which they fasten against a wall. Of this, however, later philosophers have found very great reason to doubt. It is therefore supposed that these threads, which are usually called the beard of the muscle, are the natural growth of the animal's body, and by no means produced at pleasure. Indeed, the extreme length of this beard in some, which far exceeds the length of the body, seems impossible to be manufactured by the thrusting out and drawing in of the tongue, with the glutinous matter of which the French philosopher supposed those threads were formed. It is even found to increase with the growth of the animal; and as the muscle becomes larger and older, the beard becomes longer and its filaments more strong. Be this as it may, nothing is more certain than that the muscle is found attached by these threads to every fixed object; sometimes, indeed, for want of such an object, these animals are found united to each other; and though thrown into a lake separately, they are taken out in bunches of many together.

To have some fixed resting place where the muscle can continue, and take in its accidental food, seems the state that this animal chiefly desires. Its instrument of motion, by which it contrives to reach the object it wants to bind itself to, is that muscular substance resembling a tongue, which is found long in proportion to the size of the muscle. In some it is two inches long, but in others not a third part of these dimensions. This the animal has the power of thrusting out of its shell; and with this it is capable of making a slight furrow in the sand at the bottom. By means of this furrow it can erect itself upon the edge of its shell; and thus continuing to make the furrow in proportion as it goes forward, it reaches out its tongue, that answers the purpose of an arm, and thus carries its shell edge-ways, as in a grove, until it reaches the point intended. There, where it determines to take up its residence, it fixes the ends of its beard which are glutinous, to the rock or the object, whatever it be; and thus, like a ship at anchor, braves all the agitations of the water. Sometimes the animal is attached by a large number of threads; sometimes but by three or four, that seem scarcely able to retain it. When the muscle is fixed in this manner, it lives upon the little earthy particles that the water transports to its shells, and perhaps the flesh of the most diminutive animals. However, it does not fail to grow considerably; and some of this kind have been found a foot long. I have seen the beards a foot and a half; and of this substance the natives of Palermo sometimes make gloves and stockings.

These shell-fish are found in lakes, rivers, and in the sea. Those of the lake often grow to a very large size; but they seem a solitary animal, and are found generally separate from each other. Those of rivers are not so large, but yet in greater abundance; but the sea-muscle of all others is perhaps the most plenty. These are often bred artificially in salt-water marshes that are overflowed by the tide; the fishermen throwing them in at the proper seasons; and there being undisturbed by the agitations of the sea, and not preyed upon by their powerful enemies at the bottom, they cast their eggs, which soon become perfect animals, and these are generally found in clusters of several dozens together. It requires a year for the peopling a muscle bed; so that, if the number consists of forty thousand, a tenth part may annually be left for the peopling the bed anew. Muscles are taken from their beds from the month of July to October; and they are sold at a very moderate price.

From this animal the oyster differs very little, except in the thickness of its shell, and its greater imbecility. The oyster, like the muscle, is formed with organs of life and respiration, with intestines which are very voluminous, and liver, lungs, and heart. Like the muscle, it is self-impregnated; and the shell, which the animal soon acquires, serves it for its future habitation. Like the muscle, it opens its shell to receive the influx of water; and like that animal is strongly attached to its shells both above and below.

But it differs in many particulars. In the first place its shells are not equal, the one being cupped, the other flat; upon the cupped shell it is always seen to rest; for if it lay upon the flat side it would then lose all its water. It differs also in the thickness of its shells, which are so strongly lined and defended, that no animal will attempt to pierce them. But though the oyster be secured from the attacks of the small reptiles at the bottom, yet it often serves as an object to which they are attached. Pipe-worms, and other little animals, fix their habitation to the oyster's sides, and in this manner continue to live in security. Among the number of these is a little red worm, that is often found upon the shell; which some have erroneously supposed to be the male.

The oyster differs also from the muscle in being utterly unable to change its situation. The muscle, as we have observed, is capable of erecting itself on an edge, and going forward with a slow laborious motion. The oyster is wholly passive, and endeavours by all its powers to rest fixed to one spot at the bottom. It is entirely without that tongue which we saw answering the purposes of an arm in the other animal; but nevertheless is often attached very firmly to any object it happens to approach. Rocks, stones, pieces of timber, or sea-weeds, all seem proper to give it a fixture, and to secure it against the agitation of the waves. Nothing is more common in the rivers of the tropical climates than to see oysters growing even amidst the branches of the forest. Many trees which grow along the banks of the stream often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters, like apples upon the most fertile tree; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. Thus there is nothing that these shell-fish will not stick to; they are often even found to stick to each other. This is effected by means of a glue proper to themselves, which, when it cements, the joining is as hard as the shell, and is as difficultly broken. The joining substance, however, is not always of glue; but the animal grows to the rocks, somewhat like the muscle, by threads; although these are only seen to take root in the shell, and not, as in the muscle, to spring from the body of the fish itself.

Oysters usually cast their spawn in May, which at first appear like drops of candle-grease, and stick to any hard substance they fall upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea water, it is the custom at Colchester, and other parts of the kingdom, where the tide settles in marshes on land, to pick up great quantities of small oysters along the shore, which, when first gathered, seldom exceed the size of a sixpence. These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted for being thus sheltered from the agitations of the deep; and a mixture of fresh water entering into these repositories, is said to improve their flavour, and to increase their growth and fatness.

But the oysters which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called *rock-oysters.* These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East Indies, some of whose shells we have seen two feet over! The oysters found along the coast of Coromandel are capable of furnishing a plentiful meal to eight or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy of flavour.

Thus the muscle and the oyster appear to have but few distinctions, except in their shape and the power of motion in the former. Other bivalved shell-fish, such as the cockle, the scallop, and the razor-shell, have differences equally minute. The power of changing place, which some of them effect in a manner quite peculiar to themselves, makes their greatest difference. The scallop is particularly remarkable for its method of moving forward upon land, or swimming upon the surface of the water. When this animal finds itself deserted by the tide, it makes very remarkable efforts to regain the water, moving towards the sea in a most singular manner. It first gapes with its shell as widely as it can, the edges being often an inch asunder; then it shuts them with a jerk, and by this the whole animal rises five or six inches from the ground. It thus tumbles any how forward, and then renews the operation until it has attained its journey's end. When in the water it is capable of supporting itself upon the surface; and there opening and shutting its shells, it tumbles over and over, and makes its way with some celerity.

The pivot, or razor-shell, has a very different kind of motion. As the former moves laboriously and slowly forward, so the razor-shell has only a power of sinking point downward. The shells of this animal resemble nothing so much as the haft of a razor; and by this form it is better enabled to dive into the soft sand at the bottom. All the motions of this little animal are confined to sinking or rising a foot downwards or upwards in the sand, for it is never observed to leave the spot where first it was planted. From time to time it is seen to rise about half way out of its hole; but if any way disturbed, it will sink perpendicularly down again. Just over the place where the razor buries itself, there is a small hole like a chimney, through which the animal breathes, or imbibes the sea water. Upon the desertion of the tide, these holes are easily distinguished by the fishermen who seek for it; and their method of enticing the razor up from the depth of its retreat is by sprinkling a little sea-salt upon the hole. This, melting, no sooner reaches the razor below than it rises instantly straight upwards, and shows about half its length above the surface. This appearance, however, is instantaneous; and if the fisher does not seize the opportunity, the razor buries itself with great ease to its former depth.—There it remains secure; no salt can allure it a second time; but it remains unmolested, unless the fisher will be at the trouble of digging it out sometimes two feet below the surface.

Such are the minute differences between bivalved shell-fish; but in the great outlines of their nature they exactly resemble each other. It is particularly in this class of shell-fish that pearls are found in great abundance; and it is in the internal parts of those shells that are of a shining silvery colour that these gems are usually generated; but the pearl is also found to breed as well in the muscle or the scallop as in the oyster. In fact it is found in all bivalved shells, the insides of which resemble that well-known substance called mother-of-pearl.

Whether pearls be a disease or an accident in the animal is scarcely worth inquiry. The common opinion is, that they are a kind of calculus concretion in the body of the animal, somewhat resembling a stone in the bladder, and are consequently to be considered as a disorder. It is said, in confirmation of this opinion, that those coasts upon which pearls are fished, are very unhealthy; and therefore most probably oysters share the general influence of the climate; it is also added that those oysters in which pearls are found are always ill-tasted, which is a sign of their being unsound; and, lastly, it is asserted that the pearl grows sometimes so big as to keep the shells of the animal from shutting, and that thus it dies by being exposed. It is easy to see the weakness of these assertions, which seem neither true nor amusing. To answer them in their own way: If a stone in the bladder be a disorder, a stone in the stomach of an ostrich is a benefit, and so it may be in the shell of an oyster. If the shores where the pearls are fished be unwholesome to man, that, instead of being disadvantageous, is so much the more lucky for the oyster. If the pearl oysters are the worst tasted, so are kites and ravens among birds; and yet we know that they are healthy and long-lived animals: if the oyster had ever its shell kept asunder by the pearl within it, that would be a disease indeed: but this, in reality, never happens; for the oyster that breeds a large pearl always breeds a large shell, and the shell itself indents to receive its impression. The pearl upon the whole seems bred from no disorder in the animal, but accidentally produced by the same matter that goes to form the shell. The substance, which is soft at first, quickly hardens; and thus, by successive coats, layer over layer, the pearl acquires its dimensions. If cut through, it will be found to consist of several coats, like an onion; and sometimes a small speck is seen in the middle, upon which the coats were originally formed.

All oysters, and most shell-fish, are found to contain pearls; but that which particularly obtains the name of the pearl oyster, has a large strong whitish shell, wrinkled and rough without, and within smooth and of a silver colour. From these the mother-of-pearl is taken, which is nothing more than the internal coats of the shell, resembling the pearl in colour and consistence. This is taken out and shaped into the variety of utensils which are found so beautiful, but the pearl itself is chiefly prized; being found but in a few oysters, and generally adhering, sometimes making a print in the body of the shell, sometimes at large within the substance of the fish.

There are a great number of pearl fisheries in America and Asia; but as pearls bear a worse price than formerly, those of America are in a great measure discontinued. The most famous of all the Asiatic fisheries is in the Persian Gulf, near the Isle of Bahren. There is another between the coast of Madura and the Island of Ceylon; and there was a third on the coasts of Japan: but as these noble islanders have a contempt for jewels, and an abhorrence for such Europeans as come in pursuit of them, that fishery which is thought to be the most valuable of all others, is discontinued. The diving business is now carried on only in those countries where the wretchedness of one part of mankind goes to support the magnificence of the other. The pearl fishery on the coast of Ceylon is reckoned exceedingly valuable.

The chief fishery, as was said, is carried on in the Persian Gulf, and the most valuable pearls are brought from thence. The value of these jewels increases not only in proportion to their size, but also their figure and colour; for some pearls are white, others are yellowish, others of a lead colour; and some affirm they have been found as black as jet. What it is that gives these different tinctures to pearls is not known; Tavernier ascribes it to their lying two or three weeks upon shore after the oyster is taken; Reaumur thinks it proceeds from the colour of that part of the fish's body upon which the pearl lies. It is most probable that this colour proceeds, like the spots frequently found on the internal surface of the shell itself, from some accident while the pearl is growing.

The best coloured pearls, and the roundest, are brought from the East; those of America are neither so white nor so exactly oval. All pearls, however, in time become yellow; they may be considered as an animal substance converted into a stony hardness, and like ivory taking a tincture from the air. They have been even found to decay when in damp or vaulted places, and to moulder into a substance scarcely harder than chalk. When the daughters of Stilicon, who were both betrothed, one after the other, to the emperor Honorius, were buried, much of their finery was also deposited with them in the same tomb. In this manner they remained buried for above eleven hundred years, till the foundations of the church of St. Peter were laying. Their tomb was then discovered, and all their finery was found in tolerable preservation except their pearls, which were converted by time and damps into a chalky powder.

The wretched people that are destined to fish for pearls, are either negroes or some of the poorest of the natives of Persia. The inhabitants of this country are divided into tyrants and slaves. The divers are not only subject to the dangers of the deep, to tempests, to suffocation at the bottom, to being devoured by sharks, but from their profession universally labour under a spitting of blood, occasioned by the pressure of air upon their lungs in going down to the bottom. The most robust and healthy young men are chosen for this employment, but they seldom survive it above five or six years. Their fibres become rigid; their eye-balls turn red; and they usually die consumptive.

It is amazing how very long they are observed to continue at the bottom. Some, as we are assured, have been known to continue three quarters of an hour under water without breathing; and to one unused to diving, ten minutes would suffocate the strongest. Whether from some effort the blood bursts the old passage which it had in the fœtus, and circulates without going through the lungs, it is not easy to tell; but certain it is, that some bodies have been dissected with this canal of communication open, and these extraordinary divers may be internally formed in that manner.

Be this as it may, no mode of life seems so laborious, so dangerous, or so painful. They fish for pearls, or rather the oysters that contain them, in boats twenty-eight feet long; and of these there are sometimes three or four hundred at a time, with each seven or eight stones, which serve for anchors. There are from five to eight divers belonging to each, that dive one after another. They are quite naked, except that they have a net hanging down from the neck to put their oysters in, and gloves on their hands to defend them while they pick the oysters from the holes in the rocks; for in this manner alone can they be gathered. Every diver is sunk by means of a stone, weighing fifty pounds, tied to the rope by which he descends. He places his foot in a kind of stirrup, and laying hold of the rope with his left hand, with his right he stops his nose to keep in his breath, as upon going down he takes in a very long inspiration. They are no sooner come to the bottom, but they give the signal to those who are in the boat to draw up the stone; which done, they go to work, filling their net as fast as they can; and then giving another signal, the boats above pull up the net loaded with oysters, and shortly after the diver himself to take a new inspiration. They dive to the depth of fifteen fathoms, and seldom go deeper. They generally go every morning by break of day to this fatiguing employment, taking the land wind to waft them out to sea, and returning with the sea-breeze at night. The owners of the boats usually hire the divers, and the rest of the boats crew, as we do our labourers at so much a day. All the oysters are brought on shore, where they are laid in a great heap, till the pearl fishery is over, which continues during the months of November and December. When opportunity serves, they then examine every oyster, and it is accidental whether the capture turns out advantageous. Indeed no human being can wish well to a commerce, which thus chains such a number of fellow-creatures to the bottom of the sea to pluck up a glittering, mouldering pebble.

OF MULTIVALVE SHELL-FISH.

Multivalve Shell-fish may be considered as animals shut up in round boxes. To view their habitations externally, one would be little apt to consider them as the retreats of living creatures; and still less, to suppose that some of them carry their boxes with a tolerable share of swiftness, so as to escape their pursuers. Of these there are principally two kinds; such as move, and such as are stationary: the first are usually known in our cabinets by the name of Sea-eggs; the others are as often admired, from the cavities which they scoop out for their habitation in the hardest marble. The first are called, by naturalists, Echini, or Urchins: the latter are called Pholades, or File-fish. Of both there are several sorts; but, by describing these two, we shall have a competent idea of all the rest.

To a slight view, the sea urchin may be compared to the husk of a chesnut; being like it round, and with a number of bony prickles standing out on every side. To exhibit this extraordinary animal in every light—if we could conceive a turnip stuck full of pins on every side, and running upon these pins with some degree of swiftness, we should have some idea of this extraordinary creature. The mouth is placed downwards; the vent is above; the shell is a hollow vase, resembling a scooped apple; and this filled with a soft muscular substance, through which the intestines wind from the bottom to the top. The mouth, which is placed undermost, is large and red, furnished with five sharp teeth, which are easily discerned. The jaws are strengthened by five small bones, in the centre of which is a small fleshy tongue; and from this the intestines make a winding of five spires round the internal sides of the shell, ending at the top, where the excrements are excluded. But what makes the most extraordinary part of this animal's conformation, are its horns and its spines, that point from every part of the body, like the horns of a snail, and that serve at once as legs to move upon, as arms to feel with, and as instruments of capture and defence. Between these horns it has also spines that are not endued with such a share of motion. The spines and the horns issue from every part of the body; the spines being hard and prickly; the horns being soft, longer than the spines, and never seen except in the water. They are put forward and withdrawn like the horns of a snail, and are hid at the bases of the spines, serving, as was said before, for procuring food and motion. All this apparatus, however, is only seen when the animal is hunting its prey at the bottom of the water; for a few minutes after it is taken, all the horns are withdrawn into the body and most of the spines drop off.

It has been generally said of the insects, that those which have the greatest number of legs, always move the slowest: but this animal seems to be an exception to the rule; for though furnished with two thousand spines, and twelve hundred horns, all serving for legs, and from their number seeming to impede each other's motion, yet it runs with some share of swiftness at the bottom, and it is sometimes no easy matter to overtake it. It is often taken upon the ebb, by following it in shallow water, either in an osier basket, or simply with the hand. Both the spines and the horns assist its motion; and the animal is usually seen running with the mouth downward.

Some kinds of this animal are as good eating as the lobster; and its eggs, which are of a deep red, are considered as a very great delicacy. But of others the taste is but indifferent; and in all places, except the Mediterranean, they are little sought for, except as objects of curiosity.

Very different in motion, though not much different in shape from these, are the acorn shell-fish, the thumb-footed shell-fish, and the imaginary barnacle. These are fixed to one spot, and appear to vegetate from a stalk. Indeed, to an inattentive spectator, each actually seems to be a kind of fungus that grows in the deep, destitute of animal life as well as motion. But the inquirer will soon change his opinion, when he comes to observe this mushroom-like figure more minutely. He will then see that the animal residing within the shell has not only life, but some degree of voraciousness; that it has a cover, by which it opens and shuts its shell at pleasure; that it has twelve long crooked arms, furnished with hair, which it thrusts forth for its prey; and eight smaller, which are generally kept in the shell. These are perceived adhering to every substance that is to be met with in the ocean; rocks, roots of trees, ships' bottoms, whales, lobsters, and even crabs, like bunches of grapes, clung to each other. It is amusing enough to behold their operations.—*See Anderson's History of Greenland.* They for sometime remain motionless within their shell; but when the sea is calm, they are seen opening the lid, and peeping about them. They then thrust out their long neck, look round them for some time, and then abruptly retreat back into their box, shut their lid, and lurk in darkness and security. Some people eat them; but they are in no great repute at the tables of the luxurious, where their deformed figure would be no objection to their being introduced.

Of all animals of the shelly tribe, the Pholades are the most wonderful. From their great powers of penetration, compared with their apparent imbecility, they justly excite the astonishment of the curious observer. These animals are found in different places; sometimes clothed in their proper shell, at the bottom of the water; sometimes concealed in lumps of marly earth; and sometimes lodged, shell and all, in the body of the hardest marble. In their proper shell they assume different figures; but, in general, they somewhat resemble a muscle, except that their shell is found actually composed of five or more pieces, the smaller valves serving to close up the opening left by the irregular meeting of two principal shells. But their penetration into rocks and their residence there, makes up the most wonderful part of their history.

This animal, when divested of its shell, resembles a roundish soft pudding, with no instrument that seems in the least fitted for boring into stones, or even penetrating the softest substances. It is furnished with two teeth indeed; but these are placed in such a situation as to be incapable of touching the hollow surface of its stony dwelling: it has also two covers to its shell, that open and shut at either end; but these are completely unserviceable to it as a miner. The instrument with which it performs all its operations, and buries itself in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of its shell. With this soft, yielding instrument, it perforates the most solid marbles; and having, while yet little and young, made its way, by a very narrow entrance, into the substance of the stone, it then begins to grow bigger, and thus to enlarge its apartment.

The seeming unfitness, however, of this animal for penetrating into rocks, and there forming an habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and from the petrifying quality of the water, that the whole rock afterwards hardened round them by degrees. Thus any penetrating quality, it was thought, was unjustly ascribed to them, as they only bored into a soft substance, that was hardened by time. This opinion, however, has been confuted, in a very satisfactory manner, by Doctor Bohads, who observed, that many of the pillars of the temple of Serapis at Puteoli were penetrated by these animals. From thence he very justly concludes, that the pholas must have pierced into them since they were erected; for no workmen would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected; and that the pholades have attacked them, during that time in which they continued buried under water, by means of the earthquake that swallowed up the city.

Hence it appears, that, in all Nature, there is not a greater instance of perseverance and patience than what this animal is perceived to exhibit. Furnished with the bluntest and softest auger, by slow, successive applications, it effects what other animals are incapable of performing by force; penetrating the hardest bodies only with its tongue. When, while yet naked and very small, it has effected an entrance, and has buried its body in the stone, it there continues for life at its ease; the sea water that enters at the little aperture supplying it with luxurious plenty. When the animal has taken too great a quantity of water, it is observed to spurt it out of its hole with some violence. Upon this seemingly thin diet, it quickly grows larger, and soon finds itself under a necessity of enlarging its habitation and its shell. The motion of the pholas is slow beyond conception; its progress keeps pace with the growth of its body; and, in proportion as it becomes larger, it makes its way farther into the rock. When it has got a certain way in, it then turns from its former direction, and hollows downward; till, at last, when its habitation becomes completed, the whole apartment resembles the hole of a tobacco pipe; the hole in the shank being that by which the animal entered.

Thus immured, the pholas lives in darkness, indolence, and plenty; it never removes from the narrow mansion into which it has penetrated; and seems perfectly content with being inclosed in its own sepulchre. The influx of the sea water, that enters by its little gallery, satisfies all its wants; and, without any other food, it is found to grow from seven to eight inches long, and thick in proportion.

But they are not supplied only with their rocky habitation; they have also a shell to protect them: this shell grows upon them in the body of the rock; and seems a very unnecessary addition to their defence, which they have procured themselves by art. These shells take different forms, and are often composed of a different number of valves; sometimes six; sometimes but three; sometimes the shell resembles a tube with holes at either end, one for the mouth, and the other for voiding the excrements.

Yet the pholas thus shut up, is not so solitary an animal as it would at first appear; for though it is immured in its hole without egress, though it is impossible for the animal, grown to a great size, to get out by the way it made in, yet many of this kind often meet in the heart of the rock, and, like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. Whether their thus meeting be the work of accident or of choice, few can take upon them to determine; it is, however, certain that they are most commonly found in numbers in the same rock; and sometimes above twenty are discovered within a few inches of each other.

As to the rest, this animal is found in greatest numbers at Ancona, in Italy; it is found along the shores of Normandy and Poitou, in France; it is found also upon some of the coasts of Scotland: and, in general, is considered as a very great delicacy at the tables of the luxurious.

OF FROGS AND TOADS.

OF FROGS AND TOADS IN GENERAL.

If we emerge from the deep, the first and most obvious class of amphibious animals that occur upon land are frogs and toads. Wherever they reside, they appear equally adapted for living upon land and in the water, having their hearts formed in such a manner as to dispense with the assistance of the lungs in carrying on the circulation. The frog and the toad therefore can live several days under water, without any danger of suffocation; they want but little air at the bottom; and, what is wanting, is supplied by lungs, like bladders, which are generally distended with wind, and answer all the purposes of a reservoir from whence to breathe.

To describe the form of animals so well known would be superfluous; to mark those differences that distinguish them from each may be necessary. The frog moves by leaping; the toad crawls along the ground: the frog is in general less than the toad; its colour is brighter, and with a more polished surface: the toad is brown, rough, and dusky. The frog is light and active, and its belly comparatively small; the toad is slow, swollen, and incapable of escaping. The frog, when taken, contracts itself so as to have a lump on its back; the toad's back is straight and even. Their internal parts are nearly the same, except that the lungs of the toad are more compact than those of the frog; they have air-bladders, and of consequence the animal is less fitted for living under water. Such are the differences with respect to figure and conformation; their habitudes and manners exhibit a greater variety, and require a separate description.

OF THE FROG AND ITS VARIETIES.

The external figure of the frog is so well known that it stands in little need of a description. Its power of taking large leaps is remarkably great, compared to the bulk of its body. It is the best swimmer of all four-footed animals; and Nature hath finely adapted its parts for those ends, the arms being light and active, the legs and thighs long, and furnished with very strong muscles.

If we examine this animal internally, we shall perceive that it has a very little brain for its size; a very wide swallow; a stomach seemingly small, but capable of great distension. The heart in the frog, as in all other animals that are truly amphibious, has but one ventricle; so that the blood can circulate without the assistance of the lungs, while it keeps under water. The lungs resemble a number of small bladders joined together, like the cells of a honeycomb: they are connected to the back by muscles, and can be distended or exhausted at the animal's pleasure. The male has two testiculi lying near the kidneys: and the female has two ovaries, lying near the same place. Such are the most striking peculiarities in the anatomy of a frog; and in these it agrees with the toad, the lizard, and the serpent. They are all formed internally pretty much in the same manner, with spongy lungs, a simple heart, and are destitute of the external instruments that serve to continue the kind.

Of all those who have given histories of the frog, Mr. Ræsel, of Nuremberg, seems the most accurate and entertaining. His plates of this animal are well known; his assiduity and skilfulness in observing its manners are still more deserving our esteem. Instead, therefore, of following any other, I shall take him for my guide; and though it be out of my power to amuse the reader with his beautiful designs, yet there will be some merit in transcribing his history.

The common brown frog begins to couple early in the season, and as soon as the ice is thawed from the stagnating waters. In some places the cold protracts their genial appetite till April; but it generally begins about the middle of March. The male is usually of a greyish brown colour; the female more inclines to yellow, speckled with brown.

A single female produces from six to eleven hundred eggs at a time; and, in general, she ejects them all by a single effort; though sometimes she is an hour in performing this task. The eggs, upon being emitted, expand themselves into a round form, and drop to the bottom of the water.

The egg, or little black globe, which produces a tadpole, is surrounded with two different kinds of liquor. That which immediately surrounds the globe is clear and transparent, and contained in its proper membrane; that which surrounds the whole is muddy and mucous. The transparent liquor serves for the nourishment of the tadpole from time to time; and answers the same purpose that the white of the egg does to birds. The tadpoles, when this membrane is broken, are found to adhere with their mouth to part of it; and when they got free, they immediately sink to the bottom of the water, never being able to get to the top after, while they continue in their tadpole form.

When the spawn is emitted and impregnated, it drops, as was said, to the bottom, and there the white quickly and insensibly increases. The eggs, which during the four first hours suffer no perceptible change, begin then to enlarge and grow lighter; by which means they mount to the surface of the water. At the end of eight hours, the white in which they swim grows thicker, the eggs lose their blackness, and, as they increase in size, somewhat of their spherical form. The twenty-first day, the egg is seen to open a little on one side, and the beginning of a tail to peep out, which becomes more and more distinct every day. The thirty-ninth day the little animal begins to have motion; it moves at intervals its tail; and it is perceived that the liquor in which it is circumfused, serves it for nourishment. In two days more, some of these little creatures fall to the bottom; while others remain swimming in the fluid around them, and their vivacity and motion is seen to increase Those which fall to the bottom remain there the whole day; but having lengthened themselves a little, for hitherto they are doubled up, they mount at intervals to the mucus which they had quitted, and are seen to feed upon it with great vivacity. The next day they acquire their tadpole form. In three days more they are perceived to have two little fringes, that serve as fins, beneath the head; and these, in four days after, assume a more perfect form. It is then, also, that they are seen to feed with greediness upon the pond-weed with which they are to be supplied; and, leaving their former food, on this they continue to subsist till they arrive at maturity. When they come to be ninety-two days old, two small feet are seen beginning to bourgeon near the tail: and the head appears to be separate from the body. The next day, the legs are considerably enlarged; four days after they refuse all vegetable food; their mouth appears furnished with teeth; and their hinder legs are completely formed. In two days more the arms are completely produced; and now the frog is every way perfect, except that it still continues to carry the tail. In this odd situation the animal resembling at once both a frog and a lizard, is seen frequently rising to the surface, not to take food but to breathe. In this state it continues for about six or eight hours, and then, the tail dropping off by degrees, the animal appears in its most perfect form.

Thus the frog, in less than a day, having changed its figure, is seen to change its appetites also. So extraordinary is this transformation, that the food it fed upon so voraciously but a few days before is now utterly rejected, it would even starve if supplied with no other. As soon as the animal acquires its perfect state, from having fed upon vegetables, it becomes carnivorous, and lives entirely upon worms and insects. But as the water cannot supply these, it is compelled to quit its native element, and seek for food upon land, where it lives by hunting worms, and taking insects by surprise. At first, being feeble and unable to bear the warmth of the sun, it hides among bushes and under stones; but when a shower comes to refresh the earth, then the whole multitude are seen to quit their retreats, in order to enjoy the grateful humidity. Upon many occasions the ground is seen perfectly blackened with their numbers; some hunting for prey, and some seeking secure lurking places. From the myriads that offer on such occasions, some have been induced to think that these animals were generated in the clouds, and thus showered down on the earth. But had they, like

Derham, traced them to the next pool, they would have found out a better solution for the difficulty.

The frog lives for the most part out of the water; but when the cold nights begin to set in, it returns to its native element, always choosing stagnant waters, where it can lie without danger concealed at the bottom. In this manner the frog continues torpid, or but with very little motion, the whole winter: like the rest of the dormant race, it requires no food; and the circulation is slowly carried on without any assistance from the air.

It is at the approach of spring that all these animals are roused from a state of slumber to a state of enjoyment. A short time after they rise from the bottom they begin to pair, while those that are as yet too young come upon land before the rest. For this reason, while the old ones continue concealed in the beginning of spring, the small ones are more frequently seen; the former remaining in the lake to propagate, while the latter are not yet arrived at a state of maturity.

The difference of sexes is not perceivable in these animals, until they have arrived at their fourth year; nor do they begin to propagate till they have completed that period. By comparing their slow growth with their other habitudes, it would appear that they live about twelve years; but having so many enemies, both by land and water, it is probable that few of them arrive at the end of their term.

Frogs live upon insects of all kinds; but they never eat any unless they have motion. They continue fixed and immoveable till their prey appears; and just when it comes sufficiently near, they jump forward with great agility, dart out their tongues, and seize it with certainty. The tongue, in this animal, as in the toad, lizard, and serpent kinds, is extremely long, and formed in such a manner, that it swallows the point down its throat; so that a length of tongue is thus drawn out, like a sword from its scabbard, to assail its prey. This tongue is furnished with a glutinous substance; and whatever insect it touches, infallibly adheres, and is thus held fast till it is drawn into the mouth.

As the frog is thus supplied with the power of catching its prey, it is also very vivacious, and able to bear hunger for a considerable length of time. I have known one of them continue a month in summer without any other food than the turf on which it was placed in a glass vessel. We are told of a German surgeon, who kept one eight years in a glass vessel, covered with a net. Its food was at all times but sparing; in summer he gave it fresh grass, which it is said to have fed upon; and, in the winter, hay, a little moistened: he likewise, now and then, put flies into the glass, which it would follow with an open mouth, and was very expert in catching them. In winter, when the flies were difficult to be found, it usually fell away, and grew very lean; but in the summer, when they were plenty, it soon grew fat again. It was kept in a warm room, and was always lively and ready to take its prey; however, in the eighth winter, when there were no flies to be found, it fell away and died. It is not certain how long it might have lived, had it been supplied with proper nourishment; but we are certain, that a very little food is capable of sufficing its necessities.

Nor is the frog less tenaceous of life. It will live and jump about several hours after its head has been cut off. It will continue active, though all its bowels are taken out; and it can live some days, though entirely stripped of its skin. This cruel trick, which is chiefly practised among school-boys, of skinning frogs, an operation which is done in an instant, seems for some hours no way to abate their vigour. I am assured that some of them get a new skin, and recover after this painful experiment.

The croaking of frogs is well known; and, from thence, in some countries, they are distinguished by the ludicrous title of Dutch nightingales. Indeed, the aquatic frogs of Holland are loud beyond what one could easily imagine. We could scarcely conceive that an animal, not bigger than one's fist, should be able to send forth a note that is heard at three miles distance; yet such is actually the case, as we are informed by Ræsel. The large water-frogs have a note as loud as the bellowing of a bull; and, for this purpose, puff up the cheeks to a surprising magnitude. Of all frogs, however, the male only croaks; the female is silent, and the voice in the other has been supposed to be the call to courtship. It is certain, that at such times, the loudness of their croaking is in some places very troublesome; for then the whole lake seems vocal; and a thousand dissonant notes perfectly stun the neighbourhood. At other times, also, before wet weather, their voices are in full exertion; they are then heard with unceasing assiduity, sending forth their call, and welcoming the approaches of their favourite moisture. No weather-glass was ever so true as a frog in foretelling an approaching change; and, in fact, the German surgeon, mentioned above, kept his frog for that purpose. It was always heard to croak at the approach of wet weather; but was as mute as a fish when it threatened a continuance of fair. This may probably serve to explain an opinion which some entertain, that there is a month in the year, called *Paddock Moon*, in which the frogs never croak: the whole seems to be no more than that, in the hot season, when the moisture is dried away, and consequently when these animals neither enjoy the quantity of health or food that at other times they are supplied with, they show, by their silence, how much they are displeased with the weather. All very dry weather is hurtful to their health, and hinders them from procuring their prey. They subsist chiefly upon worms and snails; and as drought prevents these from appearing, the frog is stinted in its provisions, and also wants that grateful humidity which moistens its skin, and renders it alert and active.

As frogs adhere closely to the backs of their own species, so it has been found, by repeated experience, that they will likewise adhere to the backs of fishes. Few that have ponds, but know that these animals will stick to the backs of carp, and fix their fingers in the corner of each eye. In this manner they are often caught together; the carp blinded and wasted away. Whether this proceeds from the desires of the frog, disappointed of its proper mate, or whether it be a natural enmity between frogs and fishes, I will not take upon me to say. A story told us by Walton, might be apt to incline us to the latter opinion.

'As Dubravius, a bishop of Bohemia, was walking with a friend by a large pond in that country, they saw a frog, when a pike lay very sleepily and quiet by the shore side, leap upon his head, and the frog having expressed malice or anger by his swollen cheeks and staring eyes, did stretch out his legs, and embraced the pike's head, and presently reached them to his eyes, tearing with them and his teeth those tender parts; the pike irritated with anguish, moves up and down the water, and rubs himself against weeds, and whatever he thought might quit him of his enemy, but all in vain, for the frog did continue to ride triumphantly, and to bite and torment the pike till his strength failed, and then the frog sunk with the pike to the bottom of the water: then presently the frog appeared again at the top and croaked, and seemed to rejoice like a conqueror; after which he presently retired to his secret hole. The bishop that had beheld the battle, called his fisherman to fetch his nets, and by all means to get the pike, that they might declare what had happened. The pike was drawn forth, and both his eyes eaten out; at which, when they began to wonder, the fisherman wished them to forbear, and assured them he was certain that pikes were often so served.'

OF THE TOAD AND ITS VARIETIES.

If we regard the figure of the toad, there seems nothing in it that should disgust more than that of the frog. Its form and proportions are nearly the same; and it chiefly differs in colour, which is blacker; and its slow and heavy motion, which exhibits nothing of the agility of the frog: yet such is the force of habit, begun in early prejudice, that those who consider the one as a harmless, playful animal, turn from the other with horror and disgust. The frog is considered as an useful assistant, in ridding our grounds of vermin; the toad, as a secret enemy, that only wants an opportunity to infect us with its venom.

The imagination, in this manner biassed by its terrors, paints out the toad in the most hideous colouring, and clothes it in more than natural deformity. Its body is broad; its back flat; covered with a dusky, pimpled hide; the belly is large and swagging; the pace laboured and crawling; its retreat gloomy and filthy; and its whole appearance calculated to excite disgust and horror: yet, upon my first seeing a toad, none of all these deformities in the least affected me with sensations of loathing: born, as I was, in a country where there are no toads, says Dr. Goldsmith, I had prepared my imagination for some dreadful object; but there seemed nothing to me more alarming in the sight, than in that of a common frog; and, indeed, for some time, I mistook and handled the one for the other. When first informed of my mistake, I very well remember my sensations: I wondered how I had escaped with safety, after handling and dissecting a toad, which I had mistaken for a frog. I then began to lay in a fund of horror against the whole tribe, which, though convinced they are harmless, I shall never get rid of. My first imaginations were too strong not only for my reason, but for the conviction of my senses.

As the toad bears a general resemblance of figure to the frog, so also it resembles that animal in its nature and appetites. Like the frog, the toad is amphibious; like that animal, it lives upon worms and insects, which it seizes by darting out its length of tongue; and in the same manner also it crawls about in moist weather. The male and female unite in the same manner as all the frog kind; their time of courtship being very early in the spring. Sometimes the females are seen upon land oppressed by the males, but more frequently in the water.

They propagate in England exactly in the manner of frogs; and the female, instead of retiring to dry holes, goes to the bottom of ponds, and there lies torpid all the winter, preparing to lay eggs in the beginning of spring. On these occasions, the number of males is found greatly to surpass that of the other sex, there being above thirty to one; and twelve or fourteen are often seen clinging to the same female.

When, like the frog, they have undergone all the variations of their tadpole state, they forsake the water; and are often seen, in a moist summer's evening, crawling up, by myriads, from fenny places, into dryer situations. There, having found out a retreat, or having dug themselves one with their mouth and hands, they lead a patient, solitary life, seldom venturing out, except when the moisture of a summer's evening invites them abroad. At that time the grass is filled with snails, and the pathways covered with worms, which make their principal food. Insects also of every kind they are fond of; and we have the authority of Linnæus for it, that they sometimes continue immoveable, with their mouth open, at the bottom of shrubs, where the butterflies, in some measure fascinated, are seen to fly down their throats.

In a letter from Mr. Arscott, there are some curious particulars relating to this animal, which throws great light upon its history. ‘Concerning the toad,’ says he, ‘that lived so many years with us, and was so great a favourite, the greatest curiosity was its becoming so remarkably tame: it had frequented some steps before our hall door some years before my acquaintance commenced with it, and had been admired by my father for its size, (being the largest I ever met with,) who constantly paid it a visit every evening. I knew it myself above thirty years; and by constantly feeding it, brought it to be so tame, that it always came to the candle and looked up, as if expecting to be taken up and brought upon the table, where I always fed it with insects of all sorts. It was fondest of flesh maggots, which I kept in bran; it would follow them, and when within a proper distance, would fix his eyes and remain motionless for near a quarter of a minute, as if preparing for the stroke, which was an instantaneous throwing its tongue at a great distance upon the insect, which stuck to the tip by a glutinous matter. The motion is quicker than the eye can follow. I cannot say how long my father had been acquainted with the toad, before I knew it; but when I was first acquainted with it, he used to mention it as the old toad I have known so many years: I can answer for thirty-six years. This old toad made its appearance as soon as the warm weather came; and I always concluded it retired to some dry bank, to repose till spring. When we new-layed the steps, I had two holes made in the third step, on each with a hollow of more than a yard long for it; in which I imagine it slept, as it came from thence at its first appearance. It was seldom provoked. Neither that toad, nor the multitudes I have seen tormented with great cruelty, ever showed the least desire of revenge, by spitting or emitting any juice from their pimples. Sometimes, upon taking it up, it would let out a great quantity of clear water, which, as I have often seen it do the same upon the steps when quite quiet, was certainly its urine, and no more than a natural evacuation. Spiders, millipedes, and flesh maggots, seem to be this animal’s favourite food. I imagine if a bee was to be put before a toad, it would certainly eat it to its cost; but as bees are seldom stirring at the same time that toads are, they rarely come in their way; as they do not appear after sun-rising, or before sun-set. In the heat of the day they will come to the mouth of their hole, I believe for air. I once, from my parlour window, observed a large toad I had in the bank of a bowling-green, about twelve at noon in a very hot day, very busy and active upon the grass. So uncommon an appearance made me go out to see what it was; when I found an innumerable swarm of winged ants had dropped round his hole; which temptation was as irresistible as a turtle would be to a luxurious alderman. In respect to its end, had it not been for a tame raven, I make no doubt but it would have been now living. This bird, one day seeing it at the mouth of its hole, pulled it out, and although I rescued it, pulled out one eye, and hurt it so, that notwithstanding its living a twelvemonth, it never enjoyed itself, and had a difficulty of taking its food, missing the mark for want of its eye. Before that accident, it had all the appearance of perfect health.’

To this account of the toad’s inoffensive qualities, we shall add another from Valisnieri, to show that, even taken internally, the toad is no way dangerous. ‘In the year 1692, some German soldiers, who had taken possession of the castle of Arceti, finding that the peasants of the country often amused themselves in catching frogs, and dressing them for the table; resolved to provide themselves with a like entertainment, and made preparations for frog fishing, in the same manner. It may easily be supposed that the Italians and their German guests were not very fond of each other; and indeed it is natural to think that the soldiers gave the poor people of the country many good reasons for discontent. They were not a little pleased, therefore, when they saw them go to a ditch where toads instead of frogs were found in abundance. The Germans, no way distinguishing, in their sport, caught them in great numbers; while the peasants kept looking on, silently flattering themselves with the hopes of speedy revenge. After being brought home, the toads were dressed up after the Italian fashion: the peasants quite happy at seeing their tyrants devour them with so good an appetite, and expecting every moment to see them drop down dead: but what was their surprise to find, that the Germans continued as well as ever, and only complained of a slight excoriation of the lips, which probably arose from some other cause than that of the repast.’

We shall add another story from Solenandar; who tells us, that a tradesman of Rome and his wife had long lived together with mutual discontent; the man was dropsical and the woman amorous: this ill-matched society promised soon, by the very infirm state of the man, to have an end; but the woman was unwilling to wait the progress of the disorder; and therefore concluded that, to get rid of her husband, nothing was left her but poison. For this purpose, she chose out a dose that she supposed would be the most effectual; and having calcined some toads, mixed their powder with his drink. The man, after taking a hearty dose, found no considerable inconvenience, except that it greatly promoted urine. His wife, who considered this as a beginning symptom of the venom, resolved not to stint the next dose, but gave it in greater quantities than before. This also increased the former symptom; and, in a few days, the woman had the mortification to see her detested husband restored to perfect health; and remained in utter despair of her being a widow.

From all this it is evident with what injustice this animal has hitherto been treated. It has undergone every reproach; and mankind have been taught to consider as an enemy, a creature that destroys that insect tribe which are their real invader. We are to treat, therefore, as fables, those accounts that represent the toad as possessed of poison to kill at a distance; of its ejecting its venom, which burns wherever it touches; of its infecting those vegetables near which it resides; of its excessive fondness for sage, which it renders poisonous by its approach: these, and a hundred others of the same kind, probably took rise from an antipathy which some have to all animals of the kind. It is an harmless, defenceless creature, torpid and unvenomous, and seeking the darkest retreats, not from the malignity of its nature, but the multitude of its enemies.

Like all the frog kind, the toad is torpid in winter. It chooses then for a retreat either the hollow root of a tree, the cleft of a rock, or sometimes the bottom of a pond, where it is found in a state of seeming insensibility. As it is very long-lived, it is as difficult to be killed; its skin is tough, and cannot be easily pierced; and, though covered with wounds, the animal continues to show signs of life, and every part appears in motion. But what shall we say to its living for centuries lodged in the bosom of a rock, or cased within the body of an oak tree, without the smallest access on any side either for nourishment or air, and yet taken out alive and perfect! Stories of this kind it would be as rash to contradict, as difficult to believe; we have the highest authorities bearing witness to their truth, and yet the whole analogy of Nature seems to arraign them of falsehood. Bacon asserts, that toads are found in this manner; Doctor Plot asserts the same. There is to this day a marble chimney-piece at Chatsworth with the print of the toad upon it, and a tradition of the manner in which it was found. In the Memoirs of the Academy of Sciences, for the year 1719, there is an account of a toad found alive and healthy in the heart of a very thick elm, without the smallest entrance or egress. In the year 1731, there was another found near Nantes in the heart of an old oak, without the smallest issue to its cell; and the discoverer was of opinion, from the size of the tree, that the animal could not be confined there less than eighty or a hundred years, without either sustenance or air. To all these we can only oppose the strangeness of the facts; the necessity this animal appears under of receiving air; and its dying like all other animals in the air-pump, when deprived of this all-sustaining fluid. But whether these be objections to weigh against such respectable and disinterested authority, I will not pretend to determine; certain it is, that if kept in a damp place, the toad will live for several months without any food whatsoever.

To this extraordinary account, which is doubtful, I will add another not less so; which is that of toads sucking cancerous breasts, and thus extracting the venom and performing a cure. The first account we have of this, is in a letter to the Bishop of Carlisle from Doctor Pitfield, who was the first person of consequence that attended the experiment. His letter is as follows:

'Your lordship must have taken notice of a paragraph in the papers with regard to the application of toads to a cancered breast. A patient of mine has sent to the neighbourhood of Hungerford, and brought down the very woman on whom the cure was done. I have, with all the attention I am capable of, attended the operation for eighteen or twenty days, and am surprised at the phenomenon. I am in no expectation of any great service from the application; the age, constitution, and thoroughly cancerous condition of the person, being unconquerable barriers to it. How an ailment of that kind, absolutely local, in an otherwise sound habit and of a likely age, might be relieved, I cannot say. But as to the operation, thus much I can assert, that there is neither pain nor nauseousness in it. The animal is put into a linen bag all but its head, and that is held to the part. It has generally instantly laid hold of the foulest part of the sore, and sucked with greediness until it dropped off dead. It has frequently happened that the creature has swollen immediately, and from its agonies appeared to be in great pain. I have weighed them for several days together, before and after the application, and found their increase of weight, in their different degrees, from a drachm to near an ounce. They frequently sweat exceedingly, and turn quite pale; sometimes they disgorge, recover, and become lively again: I think the whole scene is surprising, and a very remarkable piece of natural history. From the constant inoffensiveness which I have observed in them, I almost question the truth of their poisonous spitting. Many people here expect no great good from the application of toads to cancers; and where the disorder is not absolutely local, none is to be expected. When it is seated in any part not to be well come at for extirpation, I think it is hardly to be imagined, but that the having it sucked clean as often as you please, must give great relief. Every body knows that dogs licking of sores cures them, which is I suppose chiefly by keeping them clean. If there is any credit to be given to history, poisons have been sucked out. *Pallentia vulnera lambit ore venena trahens*, are the words of Lucan on the occasion. If the people to whom these words are applied did their cure by immediately following the injection of the poison, the local confinement of another poison brings the case to a great degree of similarity. I hope I have not tired your Lordship with my long tale; as it is a true one, and in my apprehension a curious piece of natural history, I could not forbear communicating it to you. I own I thought the story in the papers to be an invention; and when I considered the instinctive principle in all animals of self-preservation, I was confirmed in my disbelief: but what I have related I saw; and all theory must yield to fact. It is only the rubeth, the land-toad, which has the property of sucking: I cannot find any the least mention of the property in any one of the old naturalists. My patient can bear to have but one applied in twenty-four hours. The woman who was cured had them on day and night without intermission for five weeks. Their time of hanging at the breast has been from one to six hours.'

Other remarks made upon their method of performing this extraordinary operation are as follow: 'Some toads die very soon after they have sucked; others live about a quarter of an hour, and some much longer. For example, one that was applied about seven o'clock sucked till ten, and died as soon as it was taken from the breast; another that immediately succeeded continued till three o'clock, but dropped dead from the wound: each swelled exceedingly, and of a pale colour. They do not seem to suck greedily, and often turn their heads away; but during the time of their sucking, they were heard to smack their lips like a young child.'—*British Zoology, vol. iii. p.* 338.

From this circumstantial account of the progress of this extraordinary application, one could hardly suppose that any doubt could remain of the ingenious observer's accuracy; and yet, from information which I have received from authority still more respectable, there is much reason as yet to suspend our assent. A lady, who was under the care of the present president of the college of physicians, was induced by her friends to try the experiment; and as he saw the case was desperate, and that it would quiet her mind as well as theirs, he permitted the trial. During the whole continuance of their application, she could never thoroughly perceive that they sucked her: but that did not prevent their swelling and dying, as in the former instances. Once, indeed, she said, she thought that one of them seemed to suck; but the physician, and those who attended, could not perceive any appearance of it. Thus, after all, it is a doubt whether these animals die by the internal or the external application of the cancerous poison.

Of this animal there are several varieties; such as the water and the land-toad, which probably differ only in the ground-colour of their skin. In the first, it is more inclining to an ash-colour, with brown spots; in the other, the colour is brown, approaching to black. The water-toad is not so large as the other; but both equally breed in that element. The size of the toad with us is generally from two to four inches long; but in the fenny countries of Europe they are much larger, and not less than a common crab, when brought to table. But this is nothing to what they are discovered in some of the tropical climates, where travellers often, for the first time, mistake a toad for a tortoise. Their usual size is from six to seven inches; but there are some still larger, and as broad as a plate. Of these many are beautifully streaked and coloured; some studded over, as with pearls; others bristled with horns or spines; some have the head distinct from the body, while others have it so sunk in, that the animal appears without a head. All these are found in the tropical climates, in great abundance; and particularly after a shower of rain. It is then that the streets seem entirely paved with them; they then crawl from their retreats, and go into all places to enjoy their favourite moisture. With us the opinion of its raining toads and frogs has long been justly exploded; but it is still entertained in the tropical countries; and that not only by the savage natives, but the more refined settlers, who are apt enough to add the prejudices of other nations to their own.

It would be a tedious, as well as useless task, to enter into all the minute descriminations of these animals, as found in different countries or places; but the Pipal, or the Surinam toad, is too strange a creature not to require an exact description. There is not, perhaps, in all nature, a more extraordinary phænomenon, than that of an animal breeding and hatching its young in its back; from whence, as from a kind of hot-bed, they crawl one after the other, when come to maturity.

The pipal is in form more hideous than even the common toad; nature seeming to have marked all those strange mannered animals with peculiar deformity. The body is flat and broad; the head small; the jaws, like those of a mole, are extended, and evidently formed for rooting in the ground: the skin of the neck forms a sort of wrinkled collar: the colour of the head is of a dark chesnut, and the eyes are small: the back, which is very broad, is of a lightish grey, and seems covered over with a number of small eyes, which are round, and placed at nearly equal distances. These eyes are very different from what they seem; they are the animal's eggs, covered with their shells, and placed there for hatching. These eggs are buried deep in the skin, and in the beginning of incubation but just appear; and are very visible when the young animal is about to burst from its confinement. They are of a reddish, shining yellow colour; and the spaces between them are full of small warts, resembling pearls.

This is their situation, previous to their coming forth; but nothing so much demands our admiration, as the manner of their production. The eggs, when formed in the ovary, are sent by some internal canals, which anatomists have not hitherto described, to lie and come to maturity under the bony substance of the back: in this state they are impregnated. The skin, however, is still apparently entire, and forms a very thick covering over the whole brood; but as they advance to maturity, at different intervals, one after another, the egg seems to start forward and bourgeon from the back, becomes more yellow, and at last breaks, when the young one puts forth its head; it still, however, keeps its situation, until it has acquired a proper degree of strength, and then it leaves the shell, but still continues to keep upon the back of the parent. In this manner the pipal is seen travelling with her wonderous family on her back, in all the different stages of maturity. Some of the strange progeny, not yet come to sufficient perfection, appear quite torpid, and as yet without life in the egg: others seem just beginning to rise through the skin; here peeping forth from the shell; and there, having entirely forsaken their prison, some are sporting at large upon the parent's back; and others descending to the ground, to try their own fortune below.

Such is the description given us of this strange production by Seba, in which he differs from Ruysch, who affirms, that the young ones are bred in the back of the male only, where the female lays her eggs. I have followed Seba, however, not because he is better authority, but because he is more positive of the truth of his account, and asserts, assuredly, that the eggs are found on the back of the female only. But many circumstances are wanting towards completing his information; such as a description of the passage by which the egg finds its way into the back; the manner of its fecundation; as also a history of the manners of this strange animal itself; but, by a prolixity that too much prevails among naturalists at present, he leaves the most interesting object of curiosity, to give us a detailed description of the legs and claws of the pipal, about which we have very little concern.

The male pipal is every way larger than the female, and has the skin less tightly drawn round the body. The whole body is covered with pustules resembling pearls: and the belly, which is of a bright yellow, seems as if it were sewed up from the throat to the vent, a seam being seen to run in that direction. This animal, like the rest of the frog kind, is most probably harmless; though we are told of terrible effects resulting from its powder when calcined. This, however, must certainly be false; no creature whatever, when calcined, can be poisonous; for the fire burns away whatever might have been dangerous in their composition: all animal substances, when calcined, being entirely the same.

OF THE LIZARD KIND.

OF LIZARDS IN GENERAL.

THERE is scarcely a naturalist, who has treated of lizards, but has a particular manner of ranking them in the scale of Animated Nature. Ray, rather struck with the number of their legs, than their habits and conformation, has exalted them among quadrupeds; while Linnæus, attentive only to their long slender forms, has degraded them among serpents. Brisson gives them a distinct class by themselves, under the name of *reptiles*. Klein gives them a class inferior to beasts, under the name of *naked quadrupeds*. Some, in short, from their scaly covering, and fondness for the water, have given them to the fishes; while there have not been wanting naturalists who have classed them with insects, as the smaller kinds of this class seem to demand.

It is indeed no easy matter to tell to what class in Nature lizards are chiefly allied. They are unjustly raised to the rank of beasts, as they bring forth eggs, dispense with breathing, and are not covered with hair. They cannot be placed among fishes, as the majority of them live upon land: they are excluded from the serpent tribe, by their feet, upon which they run with some celerity; and from the insects, by their size; for though the newt may be looked upon in this contemptible light, a crocodile would be a terrible insect indeed. Thus lizards are, in some measure, excluded from every rank; while they exhibit somewhat of the properties of all; the legs and celerity of the quadruped; a facility of creeping through narrow and intricate ways, like the serpent; and a power of living in the water, like fishes; however, though endued with these various powers, they have no real advantages over any other class of Animated Nature; for what they gain in aptitude for one element, they lose in their fitness for another. Thus, between both, they are an awkward tribe; neither so alert upon land, nor so nimble in the water, as the respective inhabitants of either abode: and, indeed, this holds throughout all Nature, that in proportion as the seeming advantages of inferior animals are multiplied, their real ones abridged; and all their instincts are weakened and lost, by the variety of channels into which they are divided.

As lizards thus differ from every other class of animals, so they also differ widely from each other. With respect to size, no class of beings has its ranks so opposite. What, for instance, can be more removed than the small chamelion, an inch long, and the alligator of the river Amazons, above twenty-seven feet? To an inattentive observer, they would appear entirely of different kinds; and Seba wonders how they ever came to be classed together.

The colour of these animals also is very various, as they are found of a hundred different hues—green, blue, red, chesnut, yellow, spotted, streaked, and marbled. Were colour alone capable of constituting beauty, the lizard would often please; but there is something so repressing in the animal's figure, that the brilliancy of its scales, or the variety of its spots, only tend to give an air of more exquisite venom or greater malignity. The figure of these animals is not less various: sometimes swollen in the belly; sometimes puffed up at the throat; sometimes with a rough set of spines on the back, like the teeth of a saw; sometimes with teeth, at others with none; sometimes venomous, at others harmless, and even philanthropic; sometimes smooth and even; sometimes with a long, slender tail; and often with a shorter blunt one.

But their greatest distinction arises from the manner of bringing forth their young. Firstly, some of them are viviparous. Secondly, some are oviparous; and which may be considered in three distinct ways. Thirdly, some bring forth small spawn, like fishes. The crocodile, the Iguana, and all the largest kinds, bring forth eggs, which are hatched by the heat of the sun; the animals that issue from them are complete upon leaving the shell; and their first efforts are to run to seek food in their proper element. The viviparous kinds, in which are all the salamanders, come forth alive from the body of the female, perfect and active, and suffer no succeeding change. But those which are bred in the water, and, as we have reason to think, form spawn, suffer a very considerable change in their from. They are produced with an external skin or covering, that sometimes encloses their feet, and gives them a serpentine appearance. To this false skin fins are added, above and below the tail, that serve the animal for swimming; but when the false skin drops off, these drop off also; and then the lizard, with its four feet, is completely formed, and forsakes the water.

From hence it evidently appears, that of this tribe there are three distinct kinds, differently produced, and most probably very different in their formation. But the history of these animals is very obscure; and we are as yet incapable of laying the line that separates them. All we know, as was said before, is, that the great animals of this kind are *mostly* produced perfect from the egg; the salamanders are *generally* viviparous; and *some* of the water lizards are imperfectly produced. In all these most unfinished productions of Nature, if I may so call them, the varieties in their structure increases in proportion to their imperfections. A poet would say, that Nature grew tired of the nauseous formation; and left accident to finish the rest of her handy-work.

However, the three kinds have many points of similitude; and, in all their varieties of figure, colour, and production, this tribe is easily distinguished, and strongly marked. They have all four short legs; the two forefeet somewhat resembling a man's hand and arm. They have tails almost as thick as the body at the beginning, and these generally run tapering to a point. They are all amphibious also; equally capable of living upon land and in water; and formed internally in the same manner with the tortoise, and other animals, that can continue a long time without respiration: in other words, their lungs are not so necessary to continue life and circulation, but that their play may be stopped for some considerable time, while the blood performs its circuit round the body by a shorter communication.

These are differences that sufficiently separate lizards from all other animals; but it will be very difficult to fix the limits that distinguish the three kinds from each other. The *crocodile* tribe, and its affinities, are sufficiently distinguished from all the rest, by their size and fierceness; the *salamander* tribe is distinguished by their deformity, their frog-like heads, the shortness of their snouts, their swollen belly, and their viviparous production. With regard to the rest, which we may denominate the chamelion or lizard kind, some of which bring forth the egg, and some of which are imperfectly formed from spawn, we must place them under one head, and leave time to unravel the rest of their history.

OF THE CROCODILE AND ITS AFFINITIES.

The crocodile is an animal placed at a happy distance from the inhabitants of Europe, and formidable only in those regions where men are not so plentiful, and arts are but little known. In all the cultivated and populous parts of the world, the great animals are entirely banished, or rarely seen. The appearance of such raises at once a whole country up in arms to oppose their force; and their lives generally pay the forfeit of their temerity. The crocodile, therefore, that was once so terrible along the banks of the river Nile, is now neither so large, nor its numbers so great as formerly. The arts of mankind have, through a course of ages, powerfully operated to its destruction; and, though it is sometimes seen, it appears comparatively timorous and feeble.

To look for this animal in all its natural terrors, grown to an enormous size, propagated in surprising numbers, and committing unceasing devastations, we must go to the uninhabited regions of Africa and America, to those immense rivers that roll through extensive and desolate kingdoms, where arts have never penetrated, where force only makes distinction, and the most powerful animals exert their strength with confidence and security. Those persons who sail up the river Amazons, or the river Niger, well know how numerous and terrible those animals are in such parts of the world.—In both these rivers, they are observed from eighteen to twenty-seven feet long; and sometimes lying as close to each other, as a raft of timber upon one of our streams. There they indolently bask on the surface, no way disturbed at the approach of an enemy, since, from the repeated trials of their strength, they found none that they were not able to subdue.

Of this terrible animal there are two kinds; the crocodile, properly so called, and the cayman or alligator. Travellers, however, have rather made the distinction than Nature; for in the general outline, and in the nature of these two animals, they are entirely the same. It would be speaking more properly to call these animals the crocodiles of the eastern and the western world; for in books of voyages, they are so entirely confounded together, that there is no knowing whether the Asiatic animal be the crocodile of Asia, or the alligator of the western world. The distinctions usually made between the crocodile and alligator are these: the body of the crocodile is more slender than that of the alligator: its snout runs off tapering from the forehead, like that of a greyhound; while that of the other is indented, like the nose of a lap-dog. The crocodile has a much wider swallow, and is of an ash-colour; the alligator is black, varied with white, and is thought not to be so mischievous. But all these distinctions are very slight; and can be reckoned little more than minute variations.

This animal grows to a great length, as above mentioned, being sometimes found thirty feet long, from the tip of the snout to the end of the tail: its most usual length, however, is eighteen.—One which was dissected by the Jesuits at Siam, was of the latter dimensions; and as the description which is given of it, both externally and internally, is the most accurate known of this noted animal, I must beg leave to give it as I find it, though somewhat tedious. It was eighteen feet and a half, French measure, in length; of which the tail was no less than five feet and a half, and the head and neck about two feet and a half. It was four feet nine inches in circumference, where thickest. The fore legs had the same parts and conformation as the arms of a man, both within and without. The hands, if they may be so called, had five fingers; the two last of which had no nails, and were of a conical figure. The hinder legs, including the thigh and paw, were two feet two inches long; the paws, from the joint to the extremity of the longest claws, were above nine inches: they were divided into four toes, of which three were armed with large claws, the longest of which was an inch and a half; these toes were united by a membrane, like those of a duck, but much thicker. The head was long, and had a little rising at the top: but the rest was flat, and especially towards the extremity of the jaws. It was covered by a skin, which adhered firmly to the skull and to the jaws. The skull was rough and unequal in several places; and about the middle of the forehead there were two bony crests, about two inches high: the skull between these two crests was proof against a musket-ball; for it only rendered the part a little white that it struck against. The eye was very small, in proportion to the rest of the body, and was so placed within its orbit, that the outward part, when the lid was closed, was only an inch long, and the line running parallel to the opening of the jaws. It was covered with a double lid, one within and one without: that within, like the nictitating membrane in birds, was folded in the great corner of the eye, and had a motion towards the tail, but being transparent, it covered the eye without hindering the sight. The iris was very large in proportion to the globe of the eye, and was of a yellowish grey colour. Above the eye the ear was placed, which opened from above downwards, as if it were by a kind of spring, by means of a solid, thick, cartilaginous substance. The nose was placed in the middle of the upper jaw, near an inch from its extremity, and was perfectly round and flat, being near two inches in diameter, of a black, soft, spongy substance, not unlike the nose of a dog. The jaws seemed to shut one within another; and nothing can be more false than that the animal's under jaw is without motion; it moves, like the lower jaw in all other animals, while the other is fixed to the skull and absolutely immoveable. The animal had twenty-seven cutting teeth in the upper jaw, and fifteen in the lower, with several void spaces between them: they were thick at the bottom, and sharp at the point, being all of different sizes, except ten large hooked ones, six of which were in the lower jaw, and four in the upper. The mouth was fifteen inches in length, and eight and a half in breadth, where broadest. The distance of the two jaws, when opened as wide as they could be, was fifteen inches and a half: this is a very wide yawn, and could easily enough take in the body of a man. The colour of the body was of a dark brown on the upper part, and of a whitish citron below, with large spots of both colours on the sides. From the shoulders to the extremity of the tail, the animal was covered with large scales, of a square form, disposed like parallel girdles, and fifty-two in number; but those near the tail were not so thick as the rest. The creature was covered not only with these, but all over with a coat of armour; which, however, was not proof against a musket-ball, contrary to what has been commonly asserted: however, it must be confessed, that the attitude in which the animal was placed, might contribute to render the skin more penetrable; for, probably, if the ball had struck obliquely against the shell, it would have flown off. Those parts of the girdles underneath the belly were of a whitish colour, and were made up of scales of divers shapes, but not so hard as those on the back.

With respect to the internal parts of the animal, the gullet was large in proportion to the mouth; and a ball of wood as large as one's head, readily ran down, and was drawn up again. The guts were but short, in comparison, being not so long as the animal's body. The tongue, which some have erroneously asserted this animal was without, consisted of a thick, spongy, soft flesh, and was strongly connected to the lower jaw. The heart was of the size of a calf's, of a bright red colour, the blood passing as well from the veins to the aorta as into the lungs. There was no bladder; but the kidneys sent the urine to be discharged by the anus. There were sixty-two joints in the back-bone, which, though very closely united, had sufficient play to enable the animal to bend like a bow to the right and the left; so that what we hear of escaping the creature by turning out of the right line, and of the animal's not being able to wheel readily after its prey, seems to be fabulous. It is most likely the crocodile can turn with ease, for the joints of its back are not stiffer than those of other animals, which we know, by experience, can wheel about very nimbly for their size.

Such is the figure and conformation of this formidable animal, that unpeoples countries, and makes the most navigable rivers desert and dangerous. They are seen, in some places, lying for whole hours, and even days, stretched in the sun, and motionless; so that one not used to them might mistake them for trunks of trees, covered with a rough and dry bark; but the mistake would soon be fatal, if not prevented: for the torpid animal, at the near approach of any living thing, darts upon it with instant swiftness, and at once drags it down to the bottom. In the times of an inundation, they sometimes enter the cottages of the natives, where the dreadful visitant seizes the first animal it meets with. There have been several examples of their taking a man out of a canoe in the sight of his companions, without their being able to lend him any assistance.

The strength of every part of the crocodile is very great, and its arms, both offensive and defensive, irresistible. We have seen, from the shortness of its legs, the amazing strength of the tortoise! but what is the strength of such an animal, compared to that of the crocodile, whose legs are very short, and whose size is so superior. The back-bone is jointed in the firmest manner; the muscles of the fore and hinder legs are vigorous and strong; and its whole form calculated for force. Its teeth are sharp, numerous, and formidable; its claws are long and tenacious; but its principal instrument of destruction is the tail; with a single blow of this it has often overturned a canoe, and seized upon the poor savage, its conductor.

Though not so powerful, yet it is very terrible even upon land. The crocodile seldom, except when pressed by hunger, or with a view of depositing its eggs, leaves the water. Its usual method is to float along upon the surface and seize whatever animals come within its reach; but when this method fails, it then goes closer to the bank. Disappointed of its fishy prey, it there waits covered up among the sedges, in patient expectation of some land animal that comes to drink; the dog, the bull, the tiger, or man himself. Nothing is to be seen of the insidious destroyer as the animal approaches; nor is its retreat discovered, till it be too late for safety. It seizes the victim with a spring, and goes at a bound much faster than so unwieldy an animal could be thought capable of exerting; then having secured the creature both with its teeth and claws, it drags it into the water, instantly sinks with it to the bottom, and, in this manner, quickly drowns it.

Sometimes it happens that the creature the crocodile has thus surprised, escapes from its grasp wounded, and makes off from the river side. In such a case the tyrant pursues with all its force, and often seizes it a second time; for, though seemingly heavy, the crocodile runs with great celerity. In this manner it is sometimes seen above half a mile from the bank, in pursuit of an animal wounded beyond the power of escaping, and then dragging it back to the river-side, where it feasts in security.

It often happens, in its depredations along the bank, that the crocodile seizes on a creature as formidable as itself, and meets with a most desperate resistance. We are told of frequent combats between the crocodile and the tiger. All creatures of the tiger kind are continually oppressed by a parching thirst that keeps them in the vicinity of great rivers, whither they very frequently descend to drink. It is upon these occasions that they are seized by the crocodile; and they die not unrevenged. The instant they are seized upon, they turn with the greatest agility, and force their claws into the crocodile's eyes, while he plunges with his fierce antagonist into the river. There they continue to struggle for some time, till at last the tiger is drowned.

In this manner the crocodile seizes and destroys all animals, and is equally dreaded by all. There is no animal but man alone that can combat it with success. We are assured by Labat, that a negro, with no other weapons than a knife in his right hand, and his left arm wrapped round with a cow-hide, ventures boldly to attack this animal in its own element. As soon as he approaches the crocodile, he presents his left arm, which the animal swallows most greedily; but sticking in its throat, the negro has time to give it several stabs under the throat; and the water also getting in at the mouth, which is held involuntarily open, the creature is soon bloated up as big as a tun, and expires.

To us who live at a distance from the rapacity of these animals, these stories appear strange, and yet most probably are true. From not having seen any thing so formidable or bold in the circle of our own experience, we are not to determine upon the wonderful transactions in distant climates. It is probable that these, and a number of more dreadful encounters, happen every day among those forests, and in those rivers, where the most formidable animals are known to reside; where the elephant and the rhinoceros, the tiger and the hippopotamus, the shark and the crocodile, have frequent opportunities of meeting, and every day of renewing their engagements.

Whatever truth there may be in these accounts, certain it is that crocodiles are taken by the Siamese in great abundance. The natives of that empire seem particularly fond of the capture of all the great animals with which their country abounds. We have already noticed their success in taking and taming the elephant; nor are they less powerful in exerting their dominion over the crocodile. The manner of taking it in Siam, is by throwing three or four strong nets across a river, at proper distances from each other; so that if the animal breaks through the first, it may be caught by one of the rest. When it is first taken, it employs the tail, which is the grand instrument of strength, with great force; but after many unsuccessful struggles, the animal's strength is at last exhausted. Then the natives approach their prisoner in boats, and pierce him with their weapons in the most tender parts, till he is weakened with the loss of blood. When he is done stirring, they begin by tying up his mouth, and, with the same cord, they fasten his head to the tail, which last they bend back like a bow. However, they are not yet perfectly secure from his fury; but, for their greater safety, they tie his fore-feet, as well as those behind, to the top of his back. These precautions are not useless; for, if they were to omit them, the crocodile would soon recover strength enough to do a great deal of mischief.

The crocodile, thus brought into subjection, or bred up young, is used to divert and entertain the great men of the East. It is often managed like a horse; a curb is put into his mouth, and the rider directs it as he thinks proper. Though awkwardly formed, it does not fail to proceed with a tolerable degree of swiftness; and is thought to move as fast as some of the most unwieldy of our own animals, the hog or the cow. Some, indeed, assert, that no animal could escape it, but for its difficulty in turning; but to this resource we could wish none would trust who are so unhappy as to find themselves in danger.

Along the rivers of Africa this animal is sometimes taken in the same manner as the shark. Several Europeans go together in a large boat, and throw out a piece of beef upon a hook and strong fortified line, which the crocodile seizing and swallowing, is drawn along, floundering and struggling until its strength becomes exhausted, when it is pierced in the belly, which is its tenderest part; and thus, after numberless wounds, is drawn ashore. In this part of the world, also as well as in Siam, the crocodile makes an object of savage pomp near the palaces of their monarchs. Philips informs us, that at Sabi, on the slave coast, there are two pools of water, near the royal palace, where crocodiles are bred, as we breed carp in our ponds in Europe.

Hitherto I have been describing the crocodile as it is found in unpeopled countries, and undisturbed by frequent encounters with mankind. In this state it is exceedingly fierce and cruel, attacking every object that seems endued with motion: but in Egypt, and other countries that have been long peopled, where the inhabitants are civilized, and the rivers frequented, this animal is solitary and fearful. So far from coming to attack a man, it sinks at his approach with the utmost precipitation; and, as if sensible of superior power, regularly declines the engagement. We have seen more than one instance in Animated Nature of the contempt which at first the lower orders of the creation have for man, till they have experienced his powers of destruction. The lion and the tiger among beasts, the whale among fishes, the albatross and the penguin among birds, meet the first encounters of man without dread or apprehension; but they soon learn to acknowledge his superiority; and take refuge from his power in the deepest fastnesses of Nature. This may account for the different characters which have been given us of the crocodile and the alligator, by travellers at different times; some describing them as harmless and fearful; as ever avoiding the sight of man, and preying only upon fishes; others ranking them among the destroyers of Nature; describing them as furnished with strength, and impelled by malignity to do mischief; representing them as the greatest enemies of mankind, and particularly desirous of human prey. The truth is, the animal has been justly described by both; being such as it is found in places differently peopled or differently civilized. Wherever the crocodile has reigned long unmolested, it is there fierce, bold, and dangerous; wherever it has been harassed by mankind, its retreats invaded, and its numbers destroyed, it is there timorous and inoffensive.

In some places, therefore, this animal, instead of being formidable, is not only inoffensive, but is cherished and admired. In the river San Domingo, the crocodiles are the most inoffensive animals in Nature; the children play with them, and ride about on their backs; they even beat them sometimes without receiving the smallest injury. It is true the inhabitants are very careful of this gentle breed, and consider them as harmless domestics.

It is probable that the smell of musk, which all these animals exhale, may render them agreeable to the savages of that part of Africa. They are often known to take the part of this animal which contains the musk, and wear it as a perfume about their persons. Travellers, however, are not agreed in what part of the body these musk-bags are contained; some say in the ears; some in other parts; but the most probable opinion is, that this musky substance is amassed in the glands under the legs and arms. Nevertheless, from whatsoever part of the body this odour proceeds, it is very strong and powerful, tincturing even the flesh of the whole body with its taste and smell. The crocodile's flesh is at best very bad, tough eating; but unless the musk-bags be separated, it is unsupportable. The Negroes themselves cannot well digest the flesh; but then, a crocodile's egg is to them the most delicate morsel in the world. Even savages exhibit their epicures as well as we; and one of true taste will spare neither pains nor danger to furnish himself with his favourite repast. For this reason, he often watches the places where the female comes to lay her eggs, and, upon her retiring, seizes the booty.

All crocodiles breed near fresh waters; and though they are sometimes found in the sea, yet that may be considered rather as a place of excursion than abode. They produce their young by eggs, as was said above; and for this purpose the female, when she comes to lay, chooses a place by the side of a river, or some fresh water lake to deposit her brood in. She always pitches upon an extensive sandy shore, where she may dig a hole without danger of detection from the ground being fresh turned up. The shore must also be gentle and shelving to the water, for the greater convenience of the animal's going and returning; and a convenient place must be found near the edge of the stream, that the young may have a shorter way to go. When all these requisites are adjusted, the animal is observed cautiously stealing upon shore to deposit her burden. The presence of a man, a beast, or even a bird, is sufficient to deter her at that time: and if she perceives any creature looking on, she infallibly returns. If, however, nothing appears, she then goes to work, scratching up the sand with her fore paws, and making a hole pretty deep in the shore. There she deposits from eighty to a hundred eggs, of the size of a tennis-ball, and of the same figure, covered with a tough, white, skin-like parchment. She takes above an hour to perform this task; and then covering up the place so artfully that it can scarcely be perceived, she goes back to return again the next day. Upon her return, with the same precaution as before, she lays about the same number of eggs; and the day following also a like number. Thus having deposited her whole quantity, and having closely covered them up in the sand, they are shortly vivified by the heat of the sun; and at the end of thirty days, the young ones begin to break open the shell. At this time the female is instinctively taught that her young ones want relief; and she goes upon land to scratch away the sand and set them free. Her brood quickly avail themselves of their liberty; a part run unguided to the water; another part ascend the back of the female, and are carried thither in greater safety. But the moment they arrive at the water, all natural connexion is at an end: when the female has introduced her young to their natural element, not only she, but the male, become among the number of their most formidable enemies, and devour as many of them as they can. The whole brood scatters into different parts at the bottom; by far the greatest number are destroyed, and the rest find safety in their agility or minuteness.

But it is not the crocodile alone that is thus found to thin their numbers; the eggs of this animal are not only a delicious repast to the savage, but are eagerly sought after by every beast and bird of prey. The ichneumon was erected into a deity among the ancients for its success in destroying the eggs of these monsters: at present that species of the vulture called the Gallinazo is their most prevailing enemy. All along the banks of great rivers, for thousands of miles, the crocodile is seen to propagate in numbers that would soon overrun the earth, but for the vulture, which seems appointed by Providence to abridge its fecundity. These birds are ever found in greatest numbers where the crocodile is most numerous; and, hiding themselves within the thick branches of the trees that shade the banks of the river, they watch the female in silence, and permit her to lay all her eggs without interruption. Then when she has retired, they encourage each other with cries to the spoil; and flocking all together upon the hidden treasure, tear up the eggs, and devour them in a much quicker time than they were deposited. Nor are they less diligent in attending the female, while she is carrying her young to the water; for if any one of them happens to drop by the way, it is sure to receive no mercy.

Such is the extraordinary account given us by late travellers of the propagation of this animal; an account which has been adopted by Linnæus and the most learned naturalists of the age.—Yet, if one might argue from the general analogy of Nature, the crocodile's devouring her own young when she gets to the water seems doubtful. It is probable that this story may have been raised from the general idea of this animal's rapacious cruelty; when, in fact, the crocodile only seems more cruel than other animals, because it has more power to do mischief. But that it is not more divested of parental tenderness than other creatures is evident from its care of the young in carrying them to their natural element; and I am the more inclined to think so from the peculiar formation of one of the crocodile kind.

This is called the open-bellied crocodile, and is furnished with a false belly like the opossum, where the young creep out and in, as their dangers or necessities require. The crocodile thus furnished at least cannot be said to be an enemy to her own young, since she thus gives them more than parental protection. It is probable, likewise, that this open-bellied crocodile is viviparous, and fosters her young that are prematurely excluded in this second womb, until they come to proper maturity.

How long the crocodile lives we are not informed; if we may believe Aristotle, it lives the age of man; but the ancients so much amused themselves in inventing fables concerning this animal, that even truth from them is suspicious. What we know for certain from the ancients is, that among the various animals that were produced to fight in the Amphitheatre at Rome, the combat of the crocodile was not wanting. *(Plin. lib. viii. c. 26.)* Marcus Scaurus produced them living in his unrivalled exhibitions; and the Romans considered him as the best citizen, because he furnished them with the most expensive entertainments. But entertainment at that corrupt time was their only occupation.

OF THE SALAMANDER.

The ancients have described a lizard that is bred from heat, that lives in the flames, and feeds upon fire as its proper nourishment. As they saw every other element, the air, the earth, and water inhabited, Fancy was set to work to find or make an inhabitant in fire; and thus to people every part of Nature. It will be needless to say that there is no such animal existing; and that, of all others, the modern salamander has the smallest affinity to such an abode.

Whether the animal that now goes by the name of the salamander be the same with that described by Pliny, is a doubt with me; but it is not our inclination to discuss the question. It is sufficient to observe, that the modern salamander is an animal of the lizard kind, and under this appellation is comprehended a large tribe that all go by the same name. There have been not less than seven sorts of this animal described by Seba; and to have some idea of the peculiarity of their figure, if we suppose the tail of a lizard applied to the body of a frog, we shall not be far from precision. The common lizard is long, small, and taper; the salamander, like the frog, has its eyes towards the back of the head; like the frog, its snout is round and not pointed, and its belly thick and swollen. The claws of its toes are short and feeble; its skin rough; and the tongue, unlike that of the smallest of the lizard kind, in which it is long and forked, is short, and adhering to the under jaw. But it is not in figure that this animal chiefly differs from the rest of the lizard tribe; for it seems to be different both in its nature and conformation. In nature it is unlike, being a heavy, torpid animal; whereas the lizard tribe are active, restless, and constantly in motion: in conformation it is unlike, as the salamander is produced alive from the body of its parent, and is completely formed the moment of its exclusion. It differs from them also in its general reputation of being venomous: however, no trials that have been hitherto made seem to confirm the truth of the report.

Not only this, but many others of the lizard tribe are said to have venom; but it were to be wished that mankind, for the sake of their own happiness, would examine into the foundation of this reproach. By that means many of them, that are now shunned and detested, might be found inoffensive; their figure, instead of exciting either horror or disgust, would then only tend to animate the general scene of Nature; and speculation might examine their manners in confidence and security. Certain it is, that all of the lizard kind with which we are acquainted in England, are perfectly harmless; and it is equally true that, for a long time, till our prejudices were removed, we considered not only the Newt, but the snake and the blind-worm, as fraught with the most destructive poison. At present we have got over these prejudices; and, it is probable, that if other nations made the same efforts for information, it would be found, that the malignity of most, if not all, of the lizard tribe, was only in the imagination.

With respect to the Salamander, the whole tribe, from the moron to the gekko, are said to be venomous to the last degree; yet, when experiments have been tried, no arts, no provocations, could excite these animals to the rage of biting. They seem timid and inoffensive, only living upon worms and insects; quite destitute of fangs, like the viper; and their teeth are so very small, that they are hardly able to inflict a wound. But as the teeth are thus incapable of offending, the people of the countries where they are found have recourse to a venomous slaver, which, they suppose, issues from the animal's mouth; they also tell us of a venom issuing from the claws: even Linnæus seems to acknowledge the fact; but thinks it a probable supposition that this venom may proceed from their urine.

Of all animals, the gekko is supposed to be the most notorious for its powers of mischief: yet, we are told by those who load it with that calumny, that it is very friendly to man, and though supplied with the most deadly virulence, is yet never known to bite. It would be absurd in us, without experience, to pronounce upon the noxious or inoffensive qualities of animals: yet it is most probable, from an inspection of the teeth of lizards, and from their inoffensive qualities in Europe, that the gekko has been unjustly accused; and that its serpent-like figure has involved it in one common reproach with serpents.

The salamander best known in Europe, is from eight to eleven inches long, usually black, spotted with yellow; and when taken in the hand, feeling cold to a great degree.—There are several kinds. Our black water Newt is reckoned among the number. The idle report of its being inconsumable in fire, has caused many of these poor animals to be burnt; but we cannot say as philosophical martyrs; since scarcely any philosopher could think it necessary to make the experiment. When thrown into the fire, the animal is seen to burst with the heat of its situation, and to eject its fluids. We are gravely told, in the Philosophical Transactions, that this is a method the animal takes to extinguish the flames!

When examined internally, the salamander exhibits little difference from other animals of the lizard kind. It is furnished with lungs that sometimes serve for the offices of breathing; with a heart that has its communications open, so that the animal cannot easily be drowned. The ovary in the female is double the size of what it is in others of this tribe; and the male is furnished with four testiculi instead of two. But what deserves particular notice is the manner of this animal's bringing forth its young alive. 'The Salamander,' says my author, 'begins to shew itself in spring, and during heavy rains. When the warm weather returns it disappears; and never leaves its hole, during either great heats or severe colds, both which it equally fears. When taken in the hand, it appears like a lump of ice; consequently it loves the shade, and is found at the feet of old trees surrounded with brushwood at the bottom. It is fond of running along new ploughed grounds; probably to seek for worms, which are its ordinary food. One of these,' continues the same writer, 'I took alive some years ago in a ditch that had been lately made. I laid it at the foot of the stairs upon coming home, and there it disgorged from the throat a *worm* three inches long, that lived for an hour after, though wounded as I suppose by the teeth of the animal. I afterwards cut up another of these lizards, and saw not less than fifty young ones, resembling the parent, come from its womb, all alive, and actively running about the room.' It were to be wished the author had used another word beside that of *worm;* as we now are in doubt whether he means a real worm, or a young animal of the lizard species: had he been more explicit, and had it appeared that it was a real young lizard, which I take to be his meaning, we might here see a wonder of Nature, brought to the proof, which many have asserted, and many have thought proper to deny: I mean the refuge which the young of the shark, the lizard, and the viper kinds, are said to take, by running down the throat of the parent, and there finding a temporary security. The fact, indeed, seems a little extraordinary; and yet it is so frequently attested by some, and even believed by others, whose authority is respectable, among the number of whom we find Mr. Pennant, that the argument of strangeness must give way to the weight of authority.

However this be, there can be no doubt of the animal's being viviparous, and producing about fifty at a time. They come from the parent in full perfection, and quickly leave her to shift for themselves. These animals, in the lower ranks of Nature, want scarcely any assistance when excluded; they soon complete the little circle of their education; and in a day or two are capable of practising all the arts of subsistence and evasion practised by the generality of their kind.

They are all amphibious, or at least are found capable of subsisting in either element, when placed there: if those taken from land be put into water, they continue there in seeming health; and, on the contrary, those taken from the water will live upon land. In water, however, they exhibit a greater variety in their appearance; and what is equally wonderful with the rest of their history, during the whole spring and summer this water-lizard changes its skin every fourth or fifth day; and during the winter every fifteen days. This operation they perform by means of the mouth and the claws; and it seems a work of no small difficulty and pain. The cast skins are frequently seen floating on the surface of the water: they are sometimes seen also with a part of their old skin still sticking to one of their limbs, which they have not been able to get rid of; and thus, like a man with a boot half drawn, in some measure crippled in their own spoils. This also often corrupts, and the leg drops off; but the animal does not seem to feel the want of it, for the loss of a limb to all the lizard kind is but a trifling calamity. They can live several hours even after the loss of their head: and for some time under dissection, all the parts of this animal seem to retain life: but the tail is the part that longest retains its motion. Salt seems to be much more efficacious in destroying these animals, than the knife; for, upon being sprinkled with it, the whole body emits a viscous liquor, and the lizard dies in three minutes, in great agonies.

The whole of the lizard kind are also tenacious of life in another respect, and the salamander among the number. They sustain the want of food in a surprising manner. One of them brought from the Indies, lived nine months, without any other food than what it received from licking a piece of earth on which it was brought over, as we are informed in the Philosophical Transactions for the year 1661, numb. 21, art. 7. Another was kept by Seba in an empty vial for six months, without any nourishment; and Rhedi talks of a large one, brought from Africa, that lived for eight months, without taking any nourishment whatever.

Indeed, as many of this kind, both salamanders and lizards, are torpid, or nearly so, during the winter, the loss of their appetite for so long a time is the less surprising.

OF THE CHAMELION, THE IGUANA, AND LIZARDS OF DIFFERENT KINDS.

It were to be wished that animals could be so classed, that by the very mentioning their rank we should receive some insight into their history. This indeed I have endeavoured to do in most instances; but in the present chapter all method is totally unserviceable. Here distribution gives no general ideas: for some of the animals to be here mentioned produce by eggs, some by spawn, and some are viviparous. The peculiar manner in which each of them propagate is very indistinctly known. The iguana and the chamelion, we know, bring forth eggs; some others also produce in the same manner; but of the rest, which naturalists make to amount to above fifty, we have but very indistinct information.

In the former divisions of this tribe we had to observe upon animals, formidable from their size, or digusting from their frog-like head and appearance; in the present division all the animals are either beautiful to the eye or grateful to the appetite. The lizards, properly so called, are beautifully painted and mottled; their frolicksome agility is amusing to those who are familiar with their appearance; and the great affection which some of them show to man, should, in some measure be repaid with kindness. Others, such as the iguana, though not possessed of beauty, are very serviceable, furnishing one of the most luxurious feasts the tropical climates can boast of. Those treated of before were objects of curiosity, because they were apparently objects of danger; but most of those which are here mentioned have either use or beauty to engage us.

Directly descending from the crocodile we find the cordyle, the tockay, and the tejuguacu, all growing less in order, as I have named them. These fill up the chasm to be found between the crocodile and the African iguana.

The iguana, which deserves our notice, is about five feet long, and the body about as thick as one's thigh; the skin is covered with small scales, like those of a serpent; and the back is furnished with a row of prickles, that stand up like the teeth of a saw: the eyes seem to be but half opened, except when the animal is angry, and then they appear large and sparkling; both the jaws are full of very sharp teeth, and the bite is dangerous though not venomous, for it never lets loose till it is killed. The male has a skin hanging under his throat, which reaches down to his breast; and when displeased he puffs it up like a bladder: he is one third larger and stronger than the female; though the strength of either avails them little towards their defence. The males are ash-coloured, and the females are green.

The flesh of these may be considered as the greatest delicacy of Africa and America; and the sportsmen of these climates go out to hunt the iguana as we do in pursuit of the pheasant or the hare. In the beginning of the season, when the great floods of the tropical climates are past away, and vegetation starts into universal verdure, the sportsmen are seen, with a noose and a stick, wandering along the sides of the rivers to take the iguana. This animal, though apparently formed for combat, is the most harmless creature of all the forest: it lives among the trees, or sports in the water, without ever offering to offend; there, having fed upon the flowers of the mahot, and the leaves of the mapou, that grow along the banks of the stream, it goes to repose upon the branches of the trees that hang over the water. Upon land the animal is swift of foot; but when once in possession of a tree it seems conscious of the security of its situation, and never offers to stir. There the sportsman easily finds it, and as easily fastens his noose round his neck: if the head be placed in such a manner that the noose cannot readily be fastened, by hitting the animal a blow on the nose with the stick, it lifts the head, and offers it in some manner to the noose. In this way, and also by the tail, the iguana is dragged from the trees, and killed by repeated blows on the head.

The chamelion is a very different animal; and as the iguana satisfies the appetites of the epicure, this is rather the feast of the philospher. Like the crocodile this little animal proceeds from an egg; and it also nearly resembles that formidable creature in form, but differs widely in its size and appetite; being not above eleven inches long, and delighting to sit upon the trees, being afraid of serpents, from which it is unable to escape on the ground.

The head of a large chamelion is almost two inches long; and from thence to the beginning of the tail four and a half: the tail is five inches long, and the feet two and a half; the thickness of the body is different at different times; for sometimes, from the back to the belly, it is two inches, and sometimes but one; for it can blow itself up, and contract itself at pleasure. This swelling and contraction is not only of the back and belly, but of the legs and tail.

These different tumours do not proceed from a dilatation of the breast in breathing, which rises and falls by turns; but are very irregular, and seem adopted merely from caprice. The chamelion indeed is often seen, as it were, blown up for two hours together; and then it continues growing less and less insensibly; for the dilatation is always more quick and visible than the contraction. In this last state the animal appears extremely lean; the spine of the back seems sharp, and all the ribs may be counted; likewise the tendons of the legs and arms may be seen with great distinctness and precision.

This method of puffing itself up is similar to that in pigeons, whose crops are sometimes greatly distended with air. The chamelion has a power of driving the air it breathes over every part of the body; however, it only gets between the skin and the muscles; for the muscles themselves are never swollen. The skin is very cold to the touch; and though the animal seems so lean, there is no feeling the beating of the heart. The surface of the skin is unequal, and has a grain not unlike shagreen, but very soft, because each eminence is as smooth as if it were polished. Some of these little protuberances are as large as a pin's head, on the arms, legs, belly, and tail; but on the shoulders and head they are of an oval figure, and a little larger: those under the throat are ranged in the form of a chaplet from the lower lid to the breast. The colour of all these eminences, when the chamelion is at rest in a shady place, is of a bluish grey, and the space between is of a pale red and yellow.

But when the animal is removed into the sun, then comes the wonderful part of its history. At first it appears to suffer no change of colour, its greyish spots still continuing the same; but the whole surface soon seems to imbibe the rays of light; and the simple colouring of the body changes into a variety of beautiful hues. Wherever the light comes upon the body, it is of a tawny brown; but that part of the skin on which the sun does not shine, changes into several brighter colours, pale yellow, or vivid crimson; which forms spots of the size of half one's finger: some of these descend from the spine half way down the back; and others appear on the sides, arms, and tail. When the sun has done shining, the original grey colour returns by degrees, and covers all the body. Sometimes the animal becomes all over spotted with brown spots, of a greenish cast. When it is wrapt up in a white linen cloth for two or three minutes, the natural colour becomes much lighter; but not quite white, as some authors have pretended: it must not, however, be concluded from hence that the chamelion assumes the colour of the objects which it approaches; this is entirely an error, and probably has taken its rise from the continual changes it appears to undergo.

Le Bruyn, in his Voyage to the Levant, has given us a very ample description of the chamelion. During his stay at Smyrna, he bought several of this kind, and, to try how long they could live, kept four of them in a cage, permitting them at times to run about the house. The fresh sea-breeze seemed to give them most spirits and vivacity; they opened their mouths to take it in; he never perceived that they eat any thing, except now and then a fly, which they took half an hour to swallow: he observed their colour often to change, three or four times successively, without being able to find out any cause for such alterations; their common colour he found to be grey, or rather a pale mouse colour; but its most frequent changes were into a beautiful green, spotted with yellow; sometimes the animal was marked all over with dark brown; and this often changed into a lighter brown; but some colours it never assumed, and, contrary to what was said above, he found red to be among the number.

Though our traveller took a great deal of pains, he was unable to preserve any of them alive above five months; and many of them died in four. When the chamelion changes place, and attempts to descend from an eminence, it moves with the utmost precaution, advancing one leg very deliberately before the other, still securing itself by holding whatever it can grasp by the tail. It seldom opens its mouth, except for fresh air; and when that is supplied, discovers its satisfaction by its motions, and the frequent changes of its colour. The tongue is sometimes darted out after its prey, which is flies; and this is as long as the whole body. The eyes are remarkably little, though they stand out of the head: they have a single eye-lid, like a cap with a hole in the middle, through which the sight of the eye appears, which is of a shining brown; and round it there is a little circle of gold colour; but the most extraordinary part of their conformation is, that the animal often moves one eye, when the other is entirely at rest; nay, sometimes one eye will seem to look directly forward, while the other looks backward; and one will look upwards, while the other regards the earth.

To this class of lizards, we may refer the dragon, a most terrible animal, but most probably not of nature's formation. Of this death-dealing creature all people have read; and the most barbarous countries, to this day, paint it to the imagination in all its terrors, and fear to meet it in every forest. It is not enough that nature has furnished those countries with poisons of various malignity; with serpents forty feet long; with elephants, lions, and tigers, to make their situation really dangerous; the capricious imagination is set at work to call up new terrors; and scarcely a savage is found, that does not talk of winged serpents of immoderate length, flying away with the camel or the rhinoceros, or destroying mankind with a single glare. Happily, however, such ravages are no where found to exist at present; and the whole race of dragons is dwindled down to the flying lizard, a little harmless creature, that only preys upon insects, and even seems to embellish the forest with its beauty.

The flying lizard of Java perches upon fruit-trees, and feeds upon flies, ants, butterflies, and other small insects. It is a very harmless creature, and does no mischief in any respect. Gentil, in his Voyage round the World, affirms, that he has seen these lizards at the island of Java in the East Indies. He observed they flew very swiftly from tree to tree; and having killed one, he could not but admire the skin, which was painted with several beautiful colours: it was a foot in length, and had four paws, like the common lizards; but its head was flat, and had a small hole in the middle; the wings were very thin, and resembled those of a flying fish. About the neck were a sort of wattles, not unlike those of cocks, which gave it no disagreeable appearance. He intended to have preserved it, in order to bring it into Europe; but it was corrupted by the heat, before the close of the day; however, they have since been brought into England, and are now common enough in the cabinets of the curious.

The last animal of the lizard kind that I shall mention, is the Chalcidian lizard of Aldrovandus, very improperly called the Seps by modern historians. This animal seems to make the shade that separates the lizard from the serpent race. It has four legs, like the lizard; but so extremely short, as to be utterly unserviceable in walking: it has a long slender body, like the serpent; and it is said to have the serpent's malignity also. The fore legs are very near the head; the hind legs are placed far backward; but before and behind they seem rather useless incumbrances, than instruments serving to assist the animal in its motions, or in providing for its subsistence. These animals are found above three feet long, and thick in proportion, with a large head and pointed snout. The whole body is covered with scales; and the belly is white, mixed with blue. It has four crooked teeth, as also a pointed tail, which, however, can inflict no wound. Whether the teeth be similar to the viper's fangs, we are not told; though Volteranus says, they are covered with a membrane; by which I am apt to think he means a venom-bag, which is found at the root of the teeth of all serpents that are poisonous. It is viviparous; fifteen young ones having been taken alive out of its belly. Upon the whole, it appears to bear a strong affinity to the viper; and, like that animal, its bite may be dangerous.

OF SERPENTS, &c.

OF SERPENTS IN GENERAL.

We now come to a tribe that not only their deformity, their venom, their ready malignity, but also our prejudices, and even our religion, have taught us to detest. The serpent has from the beginning of the world, been the enemy of man; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts that have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit; and from its figure capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man though ever so earnestly bent upon its destruction.

For this reason, there is scarcely a country in the world that does not still give birth to this poisonous brood, that seem formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger, and the wolf from their vicinity; but the snake and the viper still defy their power, and frequently punish their daring interference.

Their numbers, however, are thinned by human assiduity; and it is possible that some of the kinds are even wholly destroyed. There are not any of the countries of Europe where they are sufficiently numerous to be truly terrible; the philosopher can meditate in the fields without danger, and the lover seek the grove without fearing any wounds but those of metaphor. The various malignity that has been ascribed to European serpents of old, is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. A burning pain in the part, easily removable by timely applications, is the worst effect that we experience from the bite of the most venomous serpents of Europe. The drowsy death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction, these are horrors with which we are entirely unacquainted.

But though we have thus reduced these dangers, having been incapable of wholly removing them, in some other parts of the world, it is positively asserted, that they still rage with all their ancient malignity. Nature seems to have placed them as centinels to deter mankind from spreading too widely, and from seeking new abodes till they have thoroughly cultivated those at home. In the warm countries that lie within the tropic, as well as in the cold regions of the north, where the inhabitants are few, the serpents propagate in equal proportion. But of all countries, those regions have them in the greatest abundance where the fields are unpeopled and fertile, and where the climate supplies warmth and humidity. All along the swampy banks of the river Niger or Oroonoko, where the sun is hot, the forests thick, and the men but few, the serpents cling among the branches of the trees in infinite numbers, and carry on an unceasing war against all other animals in their vicinity. Travellers have assured us that they have often seen large snakes twining round the trunk of a tall tree, encompassing it like a wreath, and thus rising and descending at pleasure. In these countries, therefore, the serpent is too formidable to become an object of curiosity, for it excites much more violent sensations.

We are not, therefore, to reject as wholly fabulous, the accounts left us by the ancients of the terrible devastations committed by a single serpent. It is probable, in early times, when the arts were little known, and mankind were but thinly scattered over the various regions of the earth, that serpents, continuing undisturbed possessors of the forest, grew to an amazing magnitude; and every other tribe of animals fell before them. It then might have happened, that serpents reigned the tyrants of a district for centuries together. To animals of this kind, grown by time and rapacity to a hundred or a hundred and fifty feet in length, the lion, the tiger, and even the elephant itself, were but feeble opponents. The dreadful monster spread desolation round him; every creature that had life was devoured, or fled to a distance. That horrible *fœtor* which even the commonest and the most harmless snakes are still found to diffuse, might, in these larger ones, become too powerful for any living being to withstand; and while they preyed without distinction, they might thus also have contaminated the atmosphere around them. In this manner, having for ages lived in the hidden and unpeopled forest, and finding, as their appetites became more powerful, the quantity of their prey decreasing, it is possible they might venture boldly from their retreats, into the more cultivated parts of the country, and carry consternation among mankind, as they had before desolation, among the lower ranks of nature. We have many histories of antiquity laying such a picture before us, and exhibiting a whole nation sinking under the ravages of a single serpent. At that time man had not learned the art of uniting the efforts of many to effect one great purpose. Opposing multitudes only added new victims to the general calamity, and increased mutual embarrassment and terror. The animal was therefore to be singly opposed by him who had the greatest strength, the best armour, and the most undaunted courage. In such an encounter hundreds must have fallen; till one, more lucky than the rest, by a fortunate blow, or by taking the monster in its torpid interval, and surcharged with spoil, might kill, and thus rid his country of the destroyer. Such was the original occupation of heroes; and those who first obtained that name, from their destroying the ravagers of the earth, gained it much more deservedly than their successors, who acquired their reputation only for their skill in destroying each other. But as we descend into more enlightened antiquity, we find these animals less formidable, as being attacked in a more successful manner. We are told, that while Regulus led his army along the banks of the river Bagrada, in Africa, an enormous serpent disputed his passage over. We are assured by Pliny, who says that he himself saw the skin, that it was a hundred and twenty feet long, and that it had destroyed many of the army. At last, however, the battering engines were brought out against it; and these assailing it at a distance, it was soon destroyed. Its spoils were carried to Rome, and the general was decreed an ovation for his success. There are, perhaps, few facts better ascertained in history than this: an ovation was a remarkable honour; and was given only for some signal exploit, that did not deserve a triumph: no historian would offer to invent that part of the story at least, without being subject to the most shameful detection. The skin was kept for several years after in the Capitol; and Pliny says, he saw it there: now, though Pliny was a credulous writer, he was by no means a *false* one; and whatever he says he has seen, we may very safely rely on. At present, indeed, such ravages from serpents are scarcely seen in any part of the world; not but that in Africa and America, some of them are powerful enough to brave the assaults of men even to the present time.

But happily for us, we are placed at such a distance as to take a view of this tribe, without fearing for our safety; we can survey their impotent malignity with the same delight with which the poet describes the terrors of a dead monster. To us their slender form, their undulating motion, their vivid colouring, their horrid stench, their forky tongue, and their envenomed fangs, are totally harmless; and in this country their uses even serve to counterbalance the mischief they sometimes occasion.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal they have lungs to breathe with; like all the reptile kind, they are resentful when offended; and Nature has supplied them with terrible arms to revenge every injury.

Although they are possessed of very different degrees of malignity, yet they are all formidable to man, and have a strong similitude of form to each other; and it will be proper to mark the general characters before we descend to particulars. With respect to their conformation, all serpents have an exceedingly wide mouth, in proportion to the size of the head; and what is very extraordinary, they can gape and swallow the head of another animal which is three times as big as their own.

I have seen a toad taken out of the belly of a snake, at Lord Spencer's, near London, the body of which was thrice the diameter of the animal that swallowed it. However, it is no way surprising that the skin of the snake should stretch to receive so large a morsel; the wonder seems how the jaws could take it in. To explain this, it must be observed, that the jaws of this animal do not open as ours, in the manner of a pair of hinges, where bones are applied to bones, and play upon one another; on the contrary, the serpent's jaws are held together at the roots by a stretching muscular skin; by which means they open as widely as the animal chooses to stretch them, and admit of a prey much thicker than the snake's own body. The throat, like what is generally called stretching leather, dilates to emit the morsel; the stomach receives it in part; and the rest remains in the gullet, till putrefaction and the juices of the serpent's body unite to dissolve it.

As to the teeth, I shall have occasion to speak of them when treating of the viper's poison; it will be sufficient here to observe, that some serpents have fangs, or canine teeth, and others are without them. The teeth in all serpents are crooked and hollow; and, by a peculiar contrivance, are capable of being erected or depressed at pleasure.

The eyes of all serpents are small, if compared to the length of the body; and though differently coloured in different kinds, yet the appearance of all is malign and heavy; and from their known qualities, they strike the imagination with the idea of a creature meditating mischief. In some, the upper eye-lid is wanting, and the serpent winks only with that below; in others, the animal has a nictitating membrane or skin, resembling that which is found in birds, which keeps the eye clean and preserves the sight. The substance of the eye in all is hard and horny; the crystaline humour occupying a great part of the globe.

The holes for hearing are very visible in all: but there are no conduits for smelling; though it is extremely probable that some of them enjoy that sense in a tolerable degree of perfection.

The tongue in all these animals is long and forky. It is composed of two long fleshy substances, which terminate in sharp points, and are very pliable. At the root it is connected very strongly to the neck by two tendons, that give a variety of play. Some of the viper kind have tongues a fifth part of the length of their bodies; they are continually darting them out, but they are entirely harmless, and only terrify those who are ignorant of the real situation of their poison.

If from the jaws we go to the gullet, we shall find it very wide for the size of the animal, and capable of being distended to a great degree; at the bottom of this lies the stomach, which is not so capacious, and receives only a part of the prey, while the rest continues in the gullet for digestion. When the substance in the stomach is dissolved into chyle, it passes into the intestines, and from thence goes to nourishment, or to be excluded by the vent.

Like most other animals, serpents are furnished with lungs, which I suppose are serviceable in breathing, though we cannot perceive the manner in which this operation is performed; for though serpents are often observed apparently to draw in their breath, yet we cannot find the smallest signs of their ever respiring it again. Their lungs, however, are long and large, and without doubt they are necessary to promote their languid circulation. The heart is formed as in the tortoise, the frog, and the lizard kinds, so as to perform its functions without the assistance of the lungs. It is single, the greatest part of the blood flowing from the great vein to the great artery by the shortest course. By this contrivance of Nature we easily gather two consequences; that snakes are amphibious, being equally capable of living on land or in the water; and, that also they are torpid in winter, like the bat, the lizard, and other animals formed in the same manner.

The vent in these animals serves for the emission of the urine and the fæces, and for other purposes. As the body of this animal is long, slender, and capable of bending in every direction, the number of joints in the back-bone are numerous beyond what one could readily imagine. In the generality of quadrupeds, they amount to not above thirty or forty; in the serpent kind they amount to a hundred and forty-five from the head to the vent, and twenty-five more from that to the tail. The number of these joints must give the back-bone a surprising degree of pliancy; but this is still increased by the manner in which each of these joints are locked into the other. In man and quadrupeds, the flat surfaces of the bones are laid one against the other, and bound tight by sinews; but in serpents the bones play one within the other like ball and socket, so that they have full motion upon each other in every direction; as we are informed by Derham, p. 396. Thus, if a man were to form a machine composed of so many joints as are found in the back of a serpent, he would find it no easy matter to give it such strength and pliancy at the same time. The chain of a watch is but a bungling piece of workmanship in comparison.

Though the number of joints in the back-bone be great, yet that of the ribs is still greater; for, from the head to the vent, there are two ribs to every joint, which makes their number two hundred and ninety in all. These ribs are furnished with muscles, four in number; which being inserted into the head, run along to the end of the tail, and give the animal great strength and agility in all its motions.

The skin also contributes to accelerate its movements, being composed of a number of scales, united to each other by a transparent membrane, which grows harder as it grows older, until the animal changes, which is generally done twice a year. This cover then bursts near the head, and the serpent creeps from it, by an undulatory motion, in a new skin, much more vivid than the former. If the old slough be then viewed, every scale will be distinctly seen, like a piece of net work, and will be found greatest where the part of the body they covered was largest.

There is much geometrical neatness in the disposal of the serpent's scales, for assisting the animal's sinuous motion. As the edges of the foremost scales lie over the ends of those which follow, so those edges, when the scales are erected, which the animal has the power of doing in a small degree, catch in the ground, like the nails in the wheel of a chariot, and so promote and facilitate the animal's progressive motion. The erecting these scales is by means of a multitude of distinct muscles, with which each is supplied, and one end of which is tacked each to the middle of the foregoing.

In some of the serpent kind there is the exactest symmetry in these scales; in others they are disposed more irregularly. In some there are larger scales on the belly, and often answering to the number of ribs; in others, however, the animal is without them. Upon this slight difference Linnæus has founded his distinctions of the various classes of the serpent tribe. Human curiosity, however, and even human interest, seem to plead for a very different method of distribution. It is not the number of scales on a formidable animal's belly, nor their magnitude or variety, that any way excite our concern. The first question that every man will naturally ask, when he hears of a snake, is, whether it be large? the second, whether it be venomous? In other words, the strongest lines in the animal's history are those that first excite our attention; and these it is the business of every historian to display.

When we come to compare serpents with each other, the first great distinction appears in their size; no other tribe of animals differing so widely in this particular. What, for instance, can be so remotely separated as the great liboya of Surinam, that grows to thirty-six feet long; and the little serpent, at the Cape of Good Hope, and the north of the river Senegal, that is not above three inches, and covers whole sandy deserts with its multitudes! This tribe of animals, like that of fishes, seems to have no bounds put to their growth; their bones are in a great measure cartilaginous, and they are consequently capable of great extension; the older, therefore, a serpent becomes, the larger it grows; and as they seem to live to a great age, they arrive at an enormous size.

Leguat assures us, that he saw one in Java that was fifty feet long. Carli mentions their growing to above forty feet, and we have now the skin of one in the British Musæum that measures thirty-two. Mr. Wentworth, who had large concerns in the Berbices in America, assures me, that in that country they grow to an enormous length. He one day sent out a soldier, with an Indian, to kill wild fowl for the table; and they accordingly went some miles from the fort; in pursuing their game, the Indian, who generally marched before, beginning to tire, went to rest himself upon the fallen trunk of a tree, as he supposed it to be; but when he was just going to sit down, the enormous monster began to move, and the poor savage perceiving that he had approached a liboya, the greatest of all the serpent kind, dropped down in an agony. The soldier, who perceived at some distance what had happened, levelled at the serpent's head, and by a lucky aim shot it dead; however, he continued his fire until he was assured that the animal was killed; and then going up to rescue his companion, who was fallen motionless by its side, he to his astonishment found him dead likewise, being killed by the fright. Upon his return to the fort, and telling what had happened, Mr. Wentworth ordered the animal to be brought up, when it was measured, and found to be thirty-six feet long. He had the skin stuffed, and then sent to Europe, as a present to the Prince of Orange, in whose cabinet it was to be seen at the Hague; but the skin had shrunk two or three feet by drying.

In the East Indies they grow also to an enormous size; particularly in the island of Java, where, we are assured, that one of them will destroy and devour a buffalo. In a letter, printed in the German Ephemerides, we have an account of a combat between an enormous serpent and a buffalo, by a person who assures us, that he was himself a spectator. The serpent had for some time been waiting near the brink of a pool, in expectation of its prey; when a buffalo was the first that offered. Having darted upon the affrighted animal, it instantly began to wrap it round with its voluminous twistings; and at every twist the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the poor animal struggled and bellowed; its enormous enemy entwined it too closely to get free; till at length all its bones being broken to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass, the serpent untwined its folds to swallow its prey at leisure. To prepare for this, and in order to make the body slip down the throat more glibly, it was seen to lick the whole body over, and thus covered it with its mucus. It then began to swallow it at that end that offered least resistance; while its length of body was dilated to receive its prey, and thus took in at once a morsel that was three times its own thickness. We are assured by travellers, that these animals are often found with the body of a stag in their gullet, while the horns, which they are unable to swallow, keep sticking out at their mouths.

But it is happy for mankind that the rapacity of these frightful creatures is often their punishment; for whenever any of the serpent kind have gorged themselves in this manner, whenever their body is seen particularly distended with food, they then become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprising degree, whenever they seize and swallow their prey, they seem, like surfeited gluttons, unwieldy, stupid, helpless, and sleepy: at that time they seek some retreat, where they may lurk for several days together, and digest their meal in safety: the smallest effort at that time is capable of destroying them; they can scarcely make any resistance: and they are equally unqualified either for flight or opposition: that is the happy opportunity of attacking them with success: at that time the naked Indian himself does not fear to assail them. But it is otherwise when this sleepy interval of digestion is over; they then issue, with famished appetites, from their retreats, and with accumulated terrors, while every animal of the forest flies before them.

Carli describes the long serpent of Congo, making its track through the tall grass, like mowers in a summer's day. He could not without terror behold whole lines of grass lying levelled under the sweep of its tail. In this manner it moved forward with great rapidity, until it found a proper situation frequented by its prey: there it continued to lurk, in patient expectation, and would have remained for weeks together, had it not been disturbed by the natives.

Other creatures have a choice in their provision; but the serpent indiscriminately preys upon all that comes it its way; the buffalo, the tiger, and the gazelle. One would think that the porcupine's quills might be sufficient to protect it; but it seems that whatever has life, serves to appease the hunger of these devouring creatures; porcupines, with all their quills, have frequently been found in their stomachs, when killed and opened; nay, they are very frequently seen to devour each other.

A life of savage hostility in the forest, offers the imagination one of the most tremendous pictures in Nature. In those burning countries, where the sun dries up every brook for hundreds of miles round; when what had the appearance of a great river in the rainy season, becomes, in summer, one dreary bed of sand—in those countries, I say, a lake that is never dry, or a brook that is perennial, is considered by every animal as the greatest convenience of Nature. As to food, the luxuriant landscape supplies that in sufficient abundance: it is the want of water that all animals endeavour to remove; and, inwardly parched by the heat of the climate, traverse whole deserts to find out a spring. When they have discovered this, no dangers can deter them from attempting to slake their thirst. Thus, the neighbourhood of a rivulet, in the heart of the tropical continents, is generally the place where all the hostile tribes of Nature draw up for the engagement. On the banks of this little envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived, in a long line, marching from the darker parts of the forest; the buffaloes are there, depending upon numbers for security; the gazelles, relying solely upon their swiftness; the lion and tiger waiting a proper opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most wakeful also; for the whole tribe sleep with their eyes open, and are, consequently, for ever upon the watch: so that, till their rapacity is satisfied, few other animals can venture to approach their station.

But though these animals are of all others, the most voracious, and though the morsel which they swallow without chewing, is greater than what any other creature, either by land or water, the whale itself not excepted, can devour, yet no animals upon earth bear abstinence so long as they. A single meal, with many of the snake kind, seems to be the adventure of a season; it is an occurrence for which they have been for weeks, nay, sometimes for months, in patient expectation of. When they have seized their prey, their industry for several weeks is entirely discontinued; the fortunate capture of an hour, often satisfies them for the remaining period of their annual activity. As their blood is colder than that of most other terrestrial animals, and as it circulates but slowly through their bodies, so their powers of digestion are but feeble. Their prey continues, for a long time, partly in the stomach, partly in the gullet, and a part is often seen hanging out of the mouth. In this manner, it digests by degrees; and in proportion as the part below is dissolved; the part above is taken in. It is not, therefore, till this tedious operation is entirely performed that the serpent renews its appetite and its activity. But should any accident prevent it from issuing once more from its cell, it can still continue to bear famine, for weeks, months, nay, for years together. Vipers are often kept in boxes for six or eight months, without any food whatever; and there are little serpents sometimes sent over to Europe from Grand Cairo, the name of which I have not been able to learn, that live for several years in glasses, and never eat at all, nor even stain the glass with their excrements. Thus the serpent tribe unite in themselves two very opposite qualities; wonderful abstinence, and yet incredible rapacity.

If, leaving the consideration of their appetites, we come to compare serpents as to their voices, some are found silent, some have a peculiar cry, but hissing is the sound which they most commonly send forth, either as a call to their kind, or as a threat to their enemies. In the countries where they abound, they are generally silent in the middle of the day, when they are obliged to retire from the heat of the climate; but as the cool of the evening approaches, they are then heard issuing from their cells, with continued hissings; and such is the variety of their notes, that some have assured me they very much resemble the music of an English grove. This some will hardly credit—at any rate, such notes, however pleasing, can give but very little delight, when we call to mind the malignity of the minstrel. If considered, indeed, as they answer the animal's own occasions, they will be found well adapted to its nature, and fully answering the purposes of terrifying such as would venture to offend it.

With respect to motion, some serpents, particularly those of the viper kind, move slowly; while others, such as the ammodytes, dart with amazing swiftness. The motion in all is similar; but the strength of body in some gives a very different appearance. The viper, that is but a slow, feeble-bodied animal, makes way in a heavy, undulating manner; advancing his head, then drawing up its tail behind, and bending the body into a bow; then from the spot where the head and tail were united, advancing the head forward as before. This, which is the motion of all serpents, is very different from that of the earth-worm or the naked snail. The serpent, as was said above, has a back-bone, with numerous joints, and this bone the animal has a power of bending in every direction, but without being able to shorten or lengthen it at pleasure. The earth-worm, on the other hand, has no back-bone; but its body is composed of rings, which, like a barber's puff, it can lengthen or shorten as it finds convenient. The earth-worm, therefore, in order to move forward, lengthens the body; then, by the fore part clings to the ground, where it has reached, and contracts and brings up its rear: then when the body is thus shortened, the fore part is lengthened again for another progression; and so on. The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression.

I have instanced this motion in the viper, as most easily discerned; but there are many serpents that dart with such amazing swiftness, that they appear rather to leap than crawl. It is most probable, however, that no serpent can dart upon even ground farther than its own length at one effort. Our fears, indeed, may increase the force of their speed, which is sometimes found so fatal. We are told by some writers, that they will dart to a very great distance; but this my inquiries have never been able to ascertain. The manner of progression in the swiftest serpent we know, which is the jaculus, is by instantly coiling itself upon its tail, and darting from thence to its full extent; then carrying the tail, as quick as lightning, to the head, coiling and darting again: and, by this means, proceeding, with extreme rapidity, without ever quitting the ground. In short, if we consider the length and the weakness of the back-bone in all these animals; if we regard the make of their vertebræ, in which we shall observe the junctures all formed to give play, and none to give power, we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a *fulcrum*, if I may so express it, from whence to take their spring; the whole body being composed of unsupported muscles and joints that are yielding. It must be confessed, that they dart down from trees upon their prey; but their weight alone is sufficient for that purpose, without much effort of their own.

Though all serpents are amphibious, some are much fonder of the water than others; and, though destitute of fins or gills, remain at the bottom, or swim along the surface with great ease. From their internal structure, just sketched above, we see how well adapted they are for either element; and how capable their blood is of circulating at the bottom, as freely as in the frog or the tortoise. They can, however, endure to live in fresh-water only; for salt is an effectual bane to the whole tribe. The greatest serpents are most usually found in fresh-water, either choosing it as their favourite element, or finding their prey in such places in the greatest abundance. But that all will live and swim in liquids appears from the experiment of Rhedi; who put a serpent into a large glass vessel of wine, where it lived swimming about six hours; though, when it was by force immersed and kept under that liquid, it lived only one hour and a half. He put another in common water, where it lived three days; but when it was kept under water, it lived only about twelve hours. Their motion there, however, is perfectly the reverse of what it is upon land; for, in order to support themselves upon an element lighter than their bodies, they are obliged to increase their surface in a very artificial manner. On earth their windings are perpendicular to the surface; in water they are parallel to it; in other words, if I should wave my hand up and down, it will give an idea of the animal's progress on land; if I should wave it to the right and left it will give some idea of its progress on the water.

Some serpents have a most horrible fætor attending them, which is alone capable of intimidating the brave. This proceeds from two glands near the vent, like those in the weasel or polecat; and, like those animals, in proportion as they are excited by rage or by fear, the scent grows stronger. But it would seem that such serpents as are most venomous, are least offensive in this particular; since the rattle-snake and the viper have no smell whatever: nay, we are told that at Calicut and Cranganore, in the East Indies, there are some very noxious serpents, who are so far from being disagreeable, that their excrements are sought after, and kept as the most fragrant and pleasing perfume. The Esculapian serpent is also considered of this number.

Some serpents bring forth their young alive, as the viper; some bring forth eggs, which are hatched by the heat of their situation; as the common black snake, and the majority of the serpent tribe. When a reader, ignorant of anatomy, is told, that some of those animals produce their young alive, and that some produce eggs only, he is apt to suppose a very great difference in the internal conformation, which makes such a variety in the manner of bringing forth. But this is not the case: these animals are internally alike, in whatever manner they produce their young; and the variety in their bringing forth is rather a slight than a real discrimination. The only difference is, that the viper hatches her eggs, and brings them to maturity within her body; the snake is more premature in her productions, and sends her eggs into the light some time before the young ones are capable of leaving the shell. Thus, if either be opened, the eggs will be found in the receptacle, covered with their membranous shell, and adhering to each other, like large beads on a string. In the eggs of both young ones will be found, though at different stages of maturity; those of the viper will crawl and bite the moment the shell that encloses them is broke open; those of the snake are not yet arrived at their perfect form.

Father Labat took a serpent of the viper kind, that was nine feet long, and ordered it to be opened in his presence. He then saw the manner in which the eggs of these animals lie in the receptacle nature has destined for them. In this creature there were six eggs, each of the size of a goose egg, but longer, more pointed, and covered with a membranous skin, by which also they were united to each other. Each of these eggs contained from thirteen to fifteen young ones, about six inches long, and as thick as a goose-quill. Though the female from whence they were taken was spotted, the young seemed to have a variety of colours very different from the parent; and this led the traveller to suppose that the colour was no characteristic mark among serpents. These little mischievous animals were no sooner let loose from the shell, than they crept about, and put themselves into a threatening posture, coiling themselves up, and biting the stick with which he was destroying them. In this manner he killed seventy-four young ones; those that were contained in one of the eggs escaped at the place where the female was killed, by the bursting of the egg, and their getting among the bushes.

The last distinction that I shall notice, but the most material among serpents, is, that some are venomous, and some inoffensive. If we consider the poison of serpents, as it relates to man, there is no doubt but that it is a scourge and an affliction. The various calamities that the poison of serpents is capable of producing are not only inflicted by the animal itself, but by men, more mischievous than even serpents, who prepare their venom to destroy each other. With this the savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day the venom of snakes is used as a philtre.

But though the poison be justly terrible to us, it has been given to very good purposes for the animal's own proper support and defence. Without this, serpents, of all other animals, would be the most exposed and defenceless: without feet for escaping a pursuit; without teeth capable of inflicting a dangerous wound, or without strength for resistance: incapable, from their size, of finding security in very small retreats, like the earth-worm, and disgusting all from their deformity, nothing was left for them but a speedy extirpation. But furnished as they are with powerful poison, every rank of animals approach them with dread, and never seize them but at an advantage. Nor is this all the advantage they derive from it. The malignity of a few serves for the protection of all. Though not above a tenth of their number are actually venomous, yet the similitude they all bear to each other excites a general detestation and terror of the whole tribe; and the uncertainty of their enemies in which the poison chiefly resides, makes even the most harmless formidable. Thus Providence seems to have acted with double precaution; it has given some of them poison for the general defence of a tribe naturally feeble; but it has thinned the numbers of those which are venomous, lest they should become too powerful for the rest of animated nature.

From these baneful qualities in the serpent kind, it is no wonder that not only man, but beasts and birds, carry on an unceasing war against them. The ichneumon of the Indians, and the peccary of America, destroy them in great numbers. These animals have the art of seizing them near the head; and it is said that they can skin them with great dexterity. The vulture and the eagle also prey upon them in great abundance; and often sousing down from the clouds, drop upon a long serpent, which they snatch up struggling and writhing in the air. Dogs also are bred up to oppose them. Father Feuillée tells us, that being in the woods of Martinico, he was attacked by a large serpent, which he could not easily avoid, when his dog immediately came to his relief, and seized the assailant with great courage. The serpent entwined him, and pressed him so violently, that the blood came out of his mouth, and yet the dog never ceased till he had tore it to pieces. The serpent dog was not sensible of his wounds during the fight;

but soon after his head swelled prodigiously, and he lay on the ground as dead. But his master having found a banana tree close at hand, he applied its juice, mixed with treakle, to the wounds, which recovered the dog, and quickly healed his sores.

But it is in man that these venomous creatures find the most dangerous enemy. The Psylli of old were famous for charming and destroying serpents. Some moderns pretend to the same art. Casaubon says, that he knew a man who could at any time summon a hundred serpents together, and draw them into the fire. Upon a certain occasion, when one of them bigger than the rest would not be brought in, he only repeated his charm, and it came forward, like the rest, to submit to the flames. Philostratus describes particularly how the Indians charm serpents. "They take a scarlet robe, embroidered with golden letters, and spread it before a serpent's hole. The golden letters have a fascinating power; and by looking steadfastly, the serpent's eyes are overcome and laid asleep.' These, and many other feats, have been often practised upon these animals by artful men, who had first prepared the serpents for their exercise, and then exhibited them as adventitiously assembled at their call. In India nothing is more common than dancing serpents, which are carried about in a broad flat vessel, somewhat resembling a sieve. These erect and put themselves in motion at the word of command. When their keeper sings a slow tune, they seem by their heads to keep time; when he sings a quicker measure, they appear to move more brisk and lively. All animals have a certain degree of docility; and we find that serpents themselves can be brought to move and approach at the voice of their master. From this trick, successfully practised before the ignorant, it is most probable has arisen all the boasted pretensions which some have made to charming of serpents; an art to which the native Americans pretend at this very day. One of Linnæus's pupils, we are told, purchased the secret from an Indian, and then discovered it to his master; but, like all secrets of the kind, it is probable this ended in a few unmeaning words of no efficacy.

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent is well known: many of the nations at present along the western coast of Africa retain the same unaccountable veneration. Upon the gold and slave coasts, a stranger, upon entering the cottages of the natives, is often surprised to see the roof swarming with serpents, that cling there without molesting, and are unmolested by the natives. But his surprise will increase upon going farther southward to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal, which travellers describe as a huge, overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues; and numbers are daily seen to offer not only their goods, their provisions, and their prayers, at the shrine of their hideous deity, but also their wives and daughters.—These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefited by the serpent's supposed embraces. Such a complicated picture of ignorance and imposture gives no very favourable impressions of our fellow-creatures; but we may say in defence of human nature, that the most frightful of reptiles is worshipped by the most uncultivated and barbarous of mankind.

From this general picture of the serpent tribe, one great distinction obviously presents itself; namely, into those that are venomous, and those that are wholly destitute of poison. To the first belong the viper, the rattle-snake, the cobra di capello, and all their affinities: to the other, the common black snake, the liboya, the boiguacu, the amphisbæna, and various others, that, though destitute of venom, do not cease to be formidable. I shall, therefore, give their history separately, beginning with the venomous class, as they have the strongest claims to our notice and attention.

OF VENOMOUS SERPENTS IN GENERAL.

The poison of serpents has been for ages one of the greatest objects of human consideration. To us, who seldom feel the vengeful wound, it is undoubtedly only a subject of curiosity; but to those placed in the midst of the serpent tribe, who are every day exposed to some new disaster, it becomes a matter of the most serious importance. To remedy the bite of a serpent is considered among our physicians, as one of the slightest operations in medicine; but among the physicians of the East, the antidotes for this calamity make up the bulk of their dispensaries. In our colder climates, the venom does not appear with that instantaneous operation which it exhibits in the warmer regions; for either its powers are less exquisite, or our fluids are not carried round in such rapid circulation.

In all countries, however, the poison of the serpent is sufficiently formidable to deserve notice, and to excite our attention to its nature and effects. It will, therefore, in the first place, be proper to describe its seat in the animal, as also the instrument by which the wound is made, and the poison injected. In all this venomous class of reptiles, whether the viper, the rattle-snake, or the cobra di capello, there are two large teeth or fangs that issue from the upper jaw, and that hang out beyond the lower. The rest of the snake tribe are destitute of these; and it is exceedingly probable that wherever these fangs are wanting, the animal is harmless; on the contrary, wherever they are found it is to be avoided as the most pestilent enemy. These are the instruments that seem to place the true distinction between animals of the serpent kind: the wounds which these fangs inflict produce the most dangerous symptoms; the wounds inflicted by the teeth only, are attended with nothing more than the ordinary consequences attending the bite of any other animal. Our first great attention, therefore, upon seeing a serpent, should be directed to the teeth. If it has the fang teeth, it is to be placed among the venomous class; if it wants them, it may be set down as inoffensive. Many serpents are said to be dangerous whose jaws are not furnished with fangs; but it is most probable that our terrors only have furnished these animals with venom; for of all the tribe whose teeth are thus formed, not one will be found to have a bag for containing poison, nor a conduit for injecting it into the wound. The black snake, the liboya, the blind worm, and a hundred others that might be mentioned, have their teeth of an equal size, fixed into the jaws, and with no other apparatus for inflicting a dangerous wound than a dog or a lizard; but it is otherwise with the venomous tribe we are now describing; these are well furnished, not only with an elaboratory where the poison is formed, but a canal by which it is conducted to the jaw, a bag under the tooth for keeping it ready for every occasion, and also an aperture in the tooth itself for injecting it into the wound. To be somewhat more particular, the glands that serve to fabricate this venomous fluid are situated on each side of the head behind the eyes, and have their canals leading from thence to the bottom of the fangs in the upper jaw, where they empty into a kind of bladder, from whence the fangs on each side are seen to grow. The venom contained in this bladder is a yellowish thick tasteless liquor, which injected into the blood is death, which may, however, be swallowed without any danger.

The fangs that give the wound come next under consideration; they are large in proportion to the size of the animal that bears them; crooked, yet sharp enough to inflict a ready wound. They grow one on each side, and sometimes two, from two moveable bones in the upper jaw, which by sliding backward or forward, have a power of erecting or depressing the teeth at pleasure. In these bones are also fixed many teeth, but no way venomous, and only serving to take and hold the animal's prey. Besides this apt disposition of the fangs, they are hollow within, and have an opening towards the point like the slit of a pen, through which, when the fang is pressed down upon the bladder where it grows, there is seen to issue a part of the venom that lay below. To describe this operation at once, when the serpent is irritated to give a venomous wound, it opens its formidable jaws to the widest extent; the moveable bones of the upper jaw slide forward; the fangs that lay before inclining are thus erected; they are struck with force into the flesh of the noxious person; by meeting resistance at the points, they press upon the bladders of venom from whence they grow; the venom issues up through the hollow of the tooth, and is pressed out through its slit into the wound, which by this time the tooth has made in the skin. Thus, from a slight puncture, and the infusion of a drop of venom scarcely larger than the head of a pin, the part is quickly inflamed, and, without a proper antidote, the whole frame contaminated.

The appearances which this venom produces are different, according to the serpent that wounds, or the season, or the strength of the animal that strikes the blow. If a viper inflicts the wound, and the remedy be neglected, the symptoms are not without danger. It first causes an acute pain in the place affected, attended with a swelling, first red, and afterwards livid. This by degrees spreads to the neighbouring parts; great faintness and a quick, though low and uninterrupted, pulse ensues: to this succeed great sickness at the stomach, bilious and convulsive vomitings, cold sweats, pains about the navel, and death itself. But the violence of the symptoms depend much on the season of the year, the difference of the climate, the size or rage of the animal, and the depth and situation of the wound. These symptoms are much more violent, and succeed each other more rapidly after the bite of a rattle-snake; but when the person is bit by the cobra di capello, he dies in an hour, his whole frame being dissolved into a putrid mass of corruption.

Nothing surely can more justly excite our astonishment, than so small a quantity of venom should produce such powerful and deadly effects. If the venom itself be examined through a microscope, it will be found to shoot into little crystals, that, to an imagination already impressed with its potency, look like so many darts fit for entering the blood-vessels, and wounding their tender coats. But all these darts are wholly of our own making; the softest and mildest fluid whatever, possessed of any consistency, will form crystals under the eye of the microscope, and put on an appearance exactly like the venom of the viper. In fact, this venom has no acrid taste whatever; and to all experiments that our senses can make upon it, appears a slimy insipid fluid. Charas, who often tasted it, assures us of the fact; and asserts, that it may be taken inwardly without any sensible effects, or any prejudice to the constitution. But the famous experiments that were tried by Rhedi and others, in the presence of the Grand Duke of Tuscany and his court, put this beyond any doubt whatsoever. By these it appeared, that the serpent having once bitten, exhausted for that time the greatest part of its poison; and though the wound caused by its biting a second time was attended by some malignant symptoms, yet they were much milder than before. It appeared that the serpent biting upon a sponge, or a piece of soft bread, and then biting a dog immediately after, did not inflict a wound more dangerous than the prick of a needle. It appeared also that the venom being collected, and a needle dipped therein, this produced almost as painful effects as the tooth of the animal itself. But what caused the greatest surprise in the court was, the seeming rashness of one Tozzi, a viper-catcher; who, while the philosophers were giving elaborate lectures on the danger of the poison when taken internally, boldly desired a large quantity of it might be put together; and then, with the utmost confidence, drank it off before them all. The court was struck with astonishment, and expected that the man would instantly fall dead; but they soon perceived their mistake, and found that taken in this manner the poison was as harmless as water.

What then shall we say to the speedy effect of so seemingly harmless a liquid taken into the circulation? Let us first observe, that milk is one of the most mild and nourishing of all fluids, and seemingly the most friendly to the human constitution; yet if milk be injected into a vein, it will quickly become fatal, and kill with more certain destruction than even the venom of the viper. From hence then we may infer, that the introducing not only the serpentine venom, but also a quantity of any other mixture, into the circulation, will be fatal; and that, consequently, serpents kill as well by their power of injecting the wound as by the potency of their poison. Some indeed may inject a more acrimonious mixture, and this may produce more speedy effects; but any mixture thus injected would be dangerous, and many would doubtless be fatal.

Ray gives us an instance of the potency of the serpent-poison; which though it has all the air of a fable, I cannot help transcribing. "A gentleman who went over to the East Indies, while he was one day sitting among some friends, was accosted by an Indian juggler, who offered to show him some experiments respecting the venom of serpents; an exhibition usual enough in that country. Having first, therefore, produced a large serpent, he assured the company that it was harmless; and to convince them of what he said, he tied up his arm, as is usual with those who are going to be bled, and whipped the serpent till it was provoked to bite him. Having drawn in this manner about half a spoonful of blood from his arm, he put the congealed clot upon his thigh. He then took out a much smaller serpent, which was no other than the cobra di capello; and having tied up its neck he procured about half a drop of its venom, which he sprinkled on the clot of blood on his thigh, which instantly began to ferment and bubble, and soon changed colour from a red into a yellow."

This, he pretended, was caused by the extreme malignity of that animal's venom; however, I have no doubt that the whole is either a fable, or a trick of the Indian's; who, while he seemed to mix the serpent's venom, actually infused some stronger ingredient, some mineral acid, into the mass of blood, which was capable of working such a change. It cannot be supposed that any animal poison could act so powerfully upon the blood already drawn and coagulated; for a poison that could operate thus instantaneously upon cold blood could not fail of soon destroying the animal itself.

Be this as it may, the effects of serpent-poison are too well known, though the manner of operation be not so well ascertained. As none of this malignant tribe grow to a great size, the longest of them not exceeding nine feet, they seldom seek the combat with larger animals, or offend others till they are first offended. Were they to exert their malignity in proportion to their power, they could easily drive the ranks of nature before them; but they seem unconscious of their own superiority, and rather fly than offer to meet the meanest opposer. Their food chiefly consists of small prey, such as birds, moles, toads, and lizards; so that they never attack the more formidable animals that would seldom die unrevenged. They lurk therefore in the clefts of rocks, or among stony places; they twine round the branches of trees, or sun themselves in the long grass at the bottom. There they only seek repose and safety. If some unwary traveller invade their retreats, their first effort is to fly; but when either pursued or accidentally trod upon, they then make a fierce and fatal resistance. For this purpose they raise themselves according to their strength upon their tail, erect their head, seize the limb that presses them, the wound is given, and the head withdrawn in a moment. It is not therefore without reason, that the Asiatics, who live in regions where serpents greatly abound, wear boots and long clothes, which very well protect their lower parts from the accidental resentment of their reptile annoyers.

In the eastern and western Indies the number of noxious serpents is various; in this country we are acquainted only with one. The viper is the only animal in Great Britain from whose bite we have any thing to be apprehensive. In the tropical climates the rattle-snake, the whip-snake, and the cobra di capello, are the most formidable, though by no means the most common. From the general notoriety of the particular serpents, and the universal terror which they occasion, it would seem that few others are possessed of such powerful malignity.

Vipers are found in many parts of this island; but the dry, stony, and particularly the chalky countries, abound with them. This animal seldom grows to a greater length than two feet; though sometimes they are found above three. The ground colour of their bodies is a dirty yellow; that of the female is deeper. The back is marked the whole length with a series of rhomboid black spots, touching each other at the points; the sides with triangular ones, the belly entirely black. It is chiefly distinguished from the common black snake by the colour, which in the latter is more beautifully mottled, as well as by the head, which is thicker than the body; but particularly by the tail, which in the viper, though it ends in a point, does not run tapering to so great a length as in the other. When, therefore, other distinctions fail, the difference of the tail can be discerned at a single glance.

The viper differs, however, from most other serpents in being much slower, as also in excluding its young completely formed, and bringing them forth alive. The kindness of Providence seems exerted, not only in diminishing the speed, but also the fertility, of this dangerous creature. They copulate in May, and are supposed to be about three months before they bring forth, and have seldom above eleven eggs at a time. These are of the size of a blackbird's egg, and chained together in the receptacle like a string of beads. Each egg contains from one to four young ones; so that the whole brood may amount to about twenty or thirty. They continue in the receptacle till they arrive at such perfection as to be able to burst from the shell; and they are said by their own efforts to creep from the confinement into the open air, where they continue for several days without taking any food whatsoever. 'We have been often assured,' says Mr. Pennant, 'by intelligent people, of the truth of a fact, that the young of the viper, when terrified, will run down the throat of the parent, and seek shelter in its belly in the same manner as the young of the opossum retire into the ventral pouch of the old one. From this,' continues he, 'some have imagined that the viper is so unnatural as to devour its own young; but this deserves no credit, as these animals live upon frogs, toads, lizards, and young birds, which they often swallow whole, though the morsel is often three times as thick as their own body.'

The viper is capable of supporting itself very long in a state of abstinence, it being known that some have been kept in a box six months without food; yet during the whole time they did not appear to abate of their vivacity. They feed only a small part of the year, but never during their confinement; for if mice, their favourite diet, should at that time be thrown into their box, though they will kill, yet they will never eat them. When at liberty, they remain torpid throughout the winter; yet, when confined, have never been observed to take their annual repose. Their poison, however, decreases in proportion to the length of their confinement; and it is thought that the virtues of the animal's flesh are, by the same restraints, considerably lessened.

They are usually taken with wooden tongs, by the end of the tail, which may be done without danger; for, while held in that position, they are unable to wind themselves up to hurt their enemy: yet, notwithstanding this precaution, the viper-catchers are frequently bit by them; but, by the application of olive-oil, the bite is effectually cured.

One William Oliver, a viper-catcher at Bath, was the first who discovered this admirable remedy. On the first of June, 1735, in the presence of a great number of persons, he suffered himself to be bit by an old black viper, (brought by one of the company,) upon the wrist and joint of the thumb of the right hand, so that drops of blood came out of the wound: he immediately felt a violent pain both at the top of his thumb, and up his arm, even before the viper was loosened from his hand; soon after he felt a pain, resembling that of burning, trickle up his arm; in a few minutes his eyes began to look red and fiery, and to water much; in less than an hour he perceived the venom seize his heart, with a pricking pain, which was attended with faintness, shortness of breath, and cold sweats; in a few minutes after this, his belly began to swell, with great gripings, and pains in his back, which were attended with vomitings and purgings: during the violence of these symptoms, his sight was gone for several minutes, but he could hear all the while. He said, that in his former experiments he had never deferred making use of his remedy longer than he perceived the effects of the venom reaching his heart; but this time, being willing to satisfy the company thoroughly, and trusting to the speedy effects of his remedy, which was nothing more than olive-oil, he forbore to apply any thing, till he found himself exceeding ill and quite giddy. About an hour and a quarter after the first of his being bit, a chafing-dish of glowing charcoal was brought in, and his naked arm was held over it, as near as he could bear, while his wife rubbed in the oil with her hand, turning his arm continually round, as if she would have roasted it over the coals: he said the poison soon abated, but the swelling did not diminish much. Most violent purging and vomitings soon ensued; and his pulse became so low, and so often interrupted, that it was thought proper to order him a repetition of cordial potions: he said he was not sensible of any great relief from these; but that a glass or two of olive-oil drank down, seemed to give him ease. Continuing in this dangerous condition, he was put to bed, where his arm was again bathed over a pan of charcoal, and rubbed with olive-oil, heated in a ladle over the charcoal, by Dr. Mortimer's direction, who was the physician that drew up the account. From this last operation he declared that he found immediate ease, as though by some charm: he soon after fell into a profound sleep, and, after about nine hours sound rest, awaked about six the next morning, and found himself very well; but in the afternoon, on drinking some rum and strong beer, so as to be almost intoxicated, the swelling returned, with much pain and cold sweats, which abated soon, on bathing the arm, as before, and wrapping it up in brown paper soaked in the oil.

Such are the effects of the viper's bite; yet its flesh has long been celebrated as a noble medicine. A broth, made by boiling one viper in a quart of water till it comes to a pint, is the usual method in which it is given at present; and it is said to be a very powerful restorative in battered constitutions; the salt of vipers is also thought to exceed any other animal salt whatever, in giving vigour to the languid circulation.

The rattle-snake is bred in America, and in no part of the old world. Some are as thick as a man's leg, and six feet in length; but the most usual size is from four to five feet long. In most particulars it resembles the viper: like that animal having a large head and a small neck, being of a dusky colour, and furnished with fangs that inflict the most terrible wounds. It differs, however, in having a large scale, which hangs like a penthouse over each eye. The eye also is furnished with a nictitating membrane, that preserves it from dust; and its scales are of a considerable degree of hardness. They are of an orange, tawny, and blackish colour on the back; and of an ash-colour on the belly, inclining to lead. The male may be readily distinguished from the female, by a black velvet spot on the head, and by the head being smaller and longer. But that which, besides their superior malignity, distinguishes them from all other animals, is their rattle, an instrument lodged in their tail, by which they make such a loud rattling noise, when they move, that their approach may readily be perceived, and the danger avoided. This rattle somewhat resembles when taken out of the body, the curb chain of a bridle: it is composed of several thin, hard, hollow bones, linked to each other, and rattling upon the slightest motion. It is supposed by some, that the snake acquires an additional bone every year; and that, from hence, its age may be precisely known: however this may be, certain it is, that the young snakes, of a year or two old, have no rattles at all; while many old ones have been killed, that have had from eleven to thirteen joints each. They shake and make a noise with these rattles with prodigious quickness when they are disturbed; however, the peccary and the vulture are no way terrified at the sound, but hasten, at the signal, to seize the snake, as their most favourite prey.

It is very different with almost every other animal. The certain death which ensues from this terrible creature's bite, makes a solitude wherever it is heard. It moves along with the most majestic rapidity; neither seeking to offend the larger animals, nor fearing their insults. If unprovoked, it never meddles with any thing but its natural prey; but when accidentally trod upon, or pursued to be destroyed, it then makes a dreadful and desperate defence. It erects itself upon its tail, throws back the head, and inflicts its wound in a moment; then parts, and inflicts a second wound: after which, we are told by some, that it remains torpid and inactive, without ever attempting to make its escape.

The very instant the wound is inflicted, though small in itself, it appears more painful than the sting of a bee. This pain, which is so suddenly felt, is far from abating, and grows every moment more excruciating and dangerous: the limb swells; the venom reaches the head, which is soon of a monstrous size; the eyes are red and fiery; the heart beats quick, with frequent interruptions: the pain becomes insupportable, and some expire under it in five or six hours; but others, who are of stronger constitutions, survive the agony for a few hours longer, only to sink under a general mortification, which ensues, and corrupts the whole body.

As a gentleman in Virginia was walking in the fields for his amusement, he accidentally trod upon a rattle-snake that had been lurking in a stony place: which, enraged by the pressure, reared up, bit his hand, and shook his rattles. The gentleman readily perceived that he was in the most dreadful danger; but, unwilling to die unrevenged, he killed the snake, and carrying it home in his hand, threw it on the ground before his family, crying out, 'I am killed, and there is my murderer!' In such an extremity, the speediest remedies were the best. His arm, which was beginning to swell, was tied up near the shoulder, the wound was anointed with oil, and every precaution taken to stop the infection. By the help of a very strong constitution he recovered; but not without feeling the most various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of several colours, with a writhing among the muscles, that, to his terrified imagination, appeared like the motions of the animal that had wounded him. A fever ensued; the loss of his hair, giddiness, drought, weakness, and nervous faintings: till, by slow degrees, a very strong habit overpowered the latent malignity of the poison.

Several remedies have been tried to alleviate this calamity. A decoction of the Virginian snake-root is considered as the most effectual; and at the same time the head of the animal bruised and laid upon the part affected, is thought to assist the cure. In general, however, it is found to be fatal; and the Indians, sensible of this, take care to dip their arrows in the poison under the rattle-snake's fangs, when they desire to take a signal revenge on their enemies.

Thus much concerning this animal is agreed upon by every naturalist: but there are other circumstances in its history which are not so well ascertained. And first, its motion, which some describe as the swiftest imaginable; asserting, that its Indian name of *Ecacoalt*, which signifies the wind-serpent, implies its agility: others, on the contrary, assert that it is the slowest and the most sluggish of all serpents; and that it seldom moves from one place. In this opposition of opinions, there are others, who assert, that on even ground it moves but slowly; but then, among rocks, that it goes at a great rate. If we may argue from analogy, the opinion of those who contend for its slow motion, seems the most probable; as the viper, which it very much resembles, is remarkable among serpents for its inactivity.

It is said also by some, that the rattle-snake has a power of charming its prey into its mouth; and this is as strongly contradicted by others. The inhabitants of Pennsylvania are said to have opportunities of observing this strange fascination every day. The snake is often seen basking at the foot of a tree, where birds and squirrels make their residence. There, coiled upon its tail, its jaws extended, and its eyes shining like fire, the rattle-snake levels its dreadful glare upon one of the little animals above. The bird, or the squirrel, whichever it may be, too plainly perceives the mischief meditating against it, and hops from branch to branch, with a timorous plaintive sound, wishing to avoid, yet incapable of breaking through the fascination; thus it continues for some time its feeble efforts and complaints, but is still seen approaching lower and lower towards the bottom branches of the tree, until at last, as if overcome by the potency of its fears, it jumps down from the tree directly into the throat of its frightful destroyer.

In order to ascertain the truth of this story, a mouse was put into a large iron cage, where a rattle-snake was kept, and the effect carefully observed. The mouse remained motionless at one end of the cage; while the snake, at the other, continued fixed, with its eye glaring full on the little animal, and its jaws opened to their widest extent: the mouse for some time seemed eager to escape; but every effort only served to increase its terrors, and to draw it still nearer the enemy; till after several ineffectual attempts to break the fascination, it was seen to run into the jaws of the rattle-snake, where it was instantly killed.

To these accounts the incredulous oppose the improbability of the fact; they assert, that such a power ascribed to serpents is only the remnant of a vulgar error, by which it was supposed that serpents could be charmed, and had also a power of charming. They aver, that animals are so far from running down the throat of a rattle-snake in captivity, that the snake will eat nothing in that state, but actually dies for want of subsistence.

A serpent, called the whip-snake, is still more venomous than the former. This animal, which is a native of the east, is about five feet long, yet not much thicker than the thong of a coachman's whip. It is exceedingly venomous; and its bite is said to kill in about six hours. One of the Jesuit missionaries, happening to enter into an Indian pagoda, saw what he took to be a whip-cord lying on the floor, and stooped to take it up; but upon handling it what was his surprise to find that it was animated, and no other than the whip-snake, of which he had heard such formidable accounts! fortune, however, seemed favourable to him, for he grasped it by the head, so that it had no power to bite him, and only twisted its folds up his arm. In this manner he held it, till it was killed by those who came to his assistance.

To this formidable class might be added the asp, whose bite, however, is not attended with those drowsy symptoms which the ancients ascribed to it. The jaculus, of Jamaica, also is one of the swiftest of the serpent kind. The hæmorrhois, so called from the *hæmorrhages* which its bite is said to produce; the seps, whose wound is very venomous, and causes the part affected to corrupt in a very short time; the coral serpent, which is red, and whose bite is said to be fatal. But of all others the cobra di capello, or hooded serpent, inflicts the most deadly and incurable wounds. Of this formidable creature there are five or six different kinds; but they are all equally dangerous, and their bite is generally followed by speedy and certain death. It is from three to eight feet long, with two large fangs hanging out of the upper jaw. It has a broad neck, and a mark of dark brown on the forehead; which, when viewed frontwise, looks like a pair of spectacles; but behind like the head of a cat. The eyes are fierce and full of fire; the head is small, and the nose flat, though covered with very large scales, of a yellowish ash-colour; the skin is white, and the large tumour on the neck is flat, and covered with oblong, smooth scales. The bite of this animal is said to be incurable, the patient dying in about an hour after receiving the wound; the whole frame being dissolved in one putrid mass of corruption.

To remedy the bite of all these animals perhaps salad-oil would be very efficacious: however, the Indians make use of a composition which is called in Europe, *petro de cobra*, or the *serpent-stone;* and which, applied to the wound, is said to draw out the venom. The composition of this stone, for it is an artificial substance, is kept a secret; and perhaps its effects in extracting the venom may be imaginary: nevertheless, it is certain that it has a power of sticking to the skin, and sucking a part of the blood from the wound. This it may do somewhat in the same manner as we see a tobacco-pipe stick to the lips of a man who is smoking: yet still we are ignorant of the manner; and the secret might probably be of some use in medicine. It were to be wished, therefore, that those who go into India would examine into this composition, and give us the result of their inquiries.

OF SERPENTS WITHOUT VENOM.

The class of serpents without poison may be distinguished from those that are venomous by their wanting the fang-teeth: their heads also are not so thick in proportion to their bodies; and in general they taper off to the tail more gradually in a point. But notwithstanding their being destitute of venom, they do not cease to be formidable: some grow to a size by which they become the most powerful animals of the forest; and even the smallest and most harmless of this slender tribe, find protection from the similitude of their form.

The fangs make the great distinction among serpents; but all this tribe are without them. Their teeth are short, numerous, and in the smaller kinds, perfectly inoffensive: they lie in either jaw, as in frogs and fishes, their points bending backwards, the better to secure their prey They want that artificial mechanism by which the poisonous tribe inflict such deadly wounds: they have no gland in the head for preparing venom; no conduits for conveying it to the teeth; no receptacles there; no hollow in the instrument that inflicts the wound. Their bite, when the teeth happen to be large enough to penetrate the skin, (for, in general, they are too small for this purpose,) is attended with no other symptoms than those of an ordinary puncture; and many of this tribe, as if sensible of their own impotence, cannot be provoked to bite, though ever so rudely assaulted.—They hiss, dart out their forky tongues, erect themselves on the tail, and call up all their terrors to intimidate their aggressors; but seem to consider their teeth as unnecessary instruments of defence, and never attempt to use them. In fact, even amongst the largest of this kind, the teeth are never employed, in the most desperate engagements. When a hare or a bird is caught, the teeth may serve to prevent such small game from escaping; but when a buffalo or a tiger is to be encountered, it is by the strong folds of the body, by the fierce verberations of the tail, that the enemy is destroyed: by this twining round, and drawing the knot with convulsive energy, this enormous reptile breaks every bone in the quadruped's body, and then, at one morsel, devours its prey.

From hence we may distinguish the unvenomous tribe into two kinds: first, into those which are seldom found of any considerable magnitude, and that never offend animals larger or more powerful than themselves, but which find their chief protection in flight, or in the doubtfulness of their form; secondly, into such as grow to an enormous size, fear no enemy, but indiscriminately attack all other animals and devour them. Of the first kind is the common black snake, the blind worm, the esculapian serpent, the amphisbæna, and several others. Of the second, the liboya, the boiguacu, the depona, and the boiquatrara.

The black snake is the largest of English serpents, sometimes exceeding four feet in length. The neck is slender; the middle of the body thick; the back and sides covered with small scales; the belly with oblong, narrow, transverse plaits: the colour of the back and sides are of a dusky brown; the middle of the back marked with two rows of small black spots, running from the head to the tail; the plaits on the belly are dusky; the scales on the sides are of a bluish white; the teeth are small and serrated, lying on each side of the jaw in two rows. The whole species is perfectly inoffensive; taking shelter in dunghills, and among bushes in moist places; from whence they seldom remove, unless in the middle of the day, in summer, when they are called out by the heat to bask themselves in the sun. If disturbed or attacked, they move away among the brambles with great swiftness: but if they are too closely pursued, they hiss and threaten, and thus render themselves formidable, though incapable of offending.

The black snake preys upon frogs, insects, worms, mice, and young birds: and, considering the smallness of the neck, it is amazing how large an animal it will swallow. The black snake of Virginia, which is larger than ours, and generally grows to six feet long, takes a prey proportionable to its size; partridges, chickens, and young ducks. It is generally found in the neighbourhood of the hen-roost, and will devour the eggs even while the hen is sitting upon them: these it swallows whole, and often after it has done the mischief will coil itself round in the nest.

The whole of this tribe are oviparous, excluding eighty or a hundred eggs at a time, which are laid in dunghills or hotbeds; the heat of which, aided by that of the sun, brings them to maturity. During winter they lie torpid, in banks of hedges, and under old trees.

The blind worm is another harmless reptile, with a formidable appearance. The usual length of this species is eleven inches. The eyes are red; the head small; the neck still more slender; from that part the body grows suddenly, and continues of an equal bulk to the tail, which ends quite blunt: the colour of the back is cinereous, marked with very small lines, composed of minute black specks; the sides are of a reddish cast; the belly dusky, and marked like the back. The motion of this serpent is slow; from which, and from the smallness of the eyes, are derived its names; some calling it the slow and some the blind worm. Like all the rest of the species in our climates, they lie torpid during the season of winter; and are sometimes found in vast numbers, twisted together. This animal, like the former, is perfectly innocent; however, like the viper, it brings forth its young alive. Gesner tells us, that one of these being struck on the head when it was pregnant, it immediately cast forth its young.

The amphisbæna, or the double-headed serpent, is remarkable for moving along with either the head or the tail foremost; and from thence it has been thought to have two heads; but this error took its rise from the thickness of the tail, which, at a distance, may be very well mistaken for another head. Upon a nearer view, however, the error is easily discovered, and the animal will be found formed according to the usual course of nature. It is as thick at one end as at the other; and the colour of the skin is like that of the earth, being rough, hard, and variously spotted. Some have affirmed, that its bite is dangerous; but this must be a mistake, as it wants the fangs, and, consequently, the elaboratory that prepares the venomous liquid.

These animals are only formidable from their similitude to the viper tribe; and, in some countries, where such reptiles are common, they make the distinction so exactly, that while they destroy serpents of one kind with great animosity, they take others into their houses, and even into their bosoms, with a kind of unaccountable affection. The esculapian serpent of Italy is among this number. It is there suffered to crawl about the chambers; and often gets into the beds where people lie. It is a yellow serpent, of about an ell long; and, though innocent, yet will bite when exasperated. They are said to be great destroyers of mice; and this may be the reason why they are taken under human protection. The boyuna of Ceylon is equally a favourite among the natives; and they consider the meeting it as a sign of good luck. The Surinam serpent, which some improperly call the ammodytes, is equally harmless and desirable among the savages of that part of the world. They consider themselves as extremely happy if this animal comes into their huts. The colours of this serpent are so many and beautiful, that they surpass all description; and these, perhaps, are the chief inducements to the savages to consider its visits as so very fortunate. A still greater favourite is the prince of serpents, a native of Japan, that has not its equal for beauty. The scales which cover the back are reddish, finely shaded, and marbled with large spots of irregular figures mixed with black. The fore part of the head is covered with large beautiful scales, the jaws bordered with yellow, the forehead marked with a black marbled streak, and the eyes handsome and lively. But of all others, the gerenda of the East Indies is the most honoured and esteemed. To this animal, which is finely spotted with various colours, the natives of Calicut pay divine honours; and while their deity lies coiled up, which is its usual posture, the people fall upon their faces before it with stupid adoration. The African gerenda is larger, and worshipped in the same manner by the inhabitants of the coasts of Mosambique. The skin is not so finely spotted as the former; but it is variegated all over the body with very fine, white, ash-coloured, and black spots. The brilliancy of colouring in these reptiles would only serve with us to increase our disgust; but in those countries where they are, common distinctions are made; and even in this horrid class, there are some eyes that can discover beauty.

But in the larger tribe of serpents, there is nothing but danger to be apprehended. This formidable class, though without venom, have something frightful in their colour, as well as in their size and form. They want that vivid hue with which the savages are so much pleased in the smaller kinds; they are all found of a dusky colour, with large teeth, which are more formidable than dangerous.

The first of this class is the great liboya of Java and Brasil, which Legaut affirms, he has seen fifty feet long. Nor is he singular in this report, as many of the missionaries affirm the same; and we have the concurrent testimony of historians as a further proof. The largest animal of this kind which has been brought into Europe, is but thirty-six feet long; and it is probable, that much greater have been seen and destroyed, before they were thought worth sending so far to satisfy European curiosity. The most usual length, however, of the liboya, is about twenty feet, and the thickness in proportion. The teeth are small in comparison with the body, nor are they used, but when it seizes the smallest prey. It lies in wait for wild animals near the paths, and when it throws itself upon them, it wraps them round so closely as to break all the bones; then moistening the whole body over with its slaver, it makes it fit for deglutition, and swallows it whole.

The boiguacu is supposed to be the next in magnitude, and has often been observed to swallow a goat whole. It is thickest in the middle of the body, and grows shorter and smaller towards the head and the tail: on the middle of the back, there is a chain of small black spots running along the length of it; and on each side, there are large, round, black spots, at some distance from each other, which are white in the centre: between these, near the belly, there are two rows of lesser black spots, which run parallel to the back. It has a double row of sharp teeth in each jaw, of a white colour, and shining like mother-of-pearl. The head is broad; and over the eyes it is raised into two prominences: near the extremity of the tail there are two claws, resembling those of birds.

These serpents conceal themselves in thickets, from whence they sally out unawares, and raising themselves upright on their tails, will attack both men and beasts. They make a loud hissing noise when exasperated; and sometimes winding up trees, will dart down upon travellers, and twist themselves so closely round their bodies, as to despatch them in a very few minutes. Condamine, however, affirms, that their bite is not dangerous; for though the teeth are so large as to inspire the beholder with terror, yet the wound they make is attended with no dangerous consequences whatever. Dellon affirms, that they generally haunt desert places; and though they are sometimes observed near great towns, or on the banks of rivers, yet it is generally after some great inundation: he never saw any but what were dead; and they appeared to him like the trunk of a great tree lying on the ground.

To this class of large serpents we may refer the depona, a native of Mexico, with a very large head and great jaws. The mouth is armed with cutting, crooked teeth, among which there are two longer than the rest, placed in the fore part of the upper jaw, but very different from the fangs of the viper. All round the mouth there is a broad scaly border; and the eyes are so large that they give it a very terrible aspect. The forehead is covered with large scales; on which are placed others that are smaller, curiously ranged: those on the back are greyish, and along it runs a double chain, whose ends are joined in the manner of a buckler. Each side of the belly is marbled with large square spots, of a chesnut colour, in the middle of which is a spot which is round and yellow. They avoid the sight of man; and, consequently, never do much harm.

Such are the most noted animals of the serpent tribe; but to recount all would be a vain, as well as a useless endeavour. In those countries where they abound, their discriminations are so numerous, and their colours so various, that every thicket seems to produce a new animal. The same serpent is often found to bring forth animals of eight or ten different colours; and the naturalist who attempts to arrange them by that criterion will find that he has made distinctions which are entirely disowned by nature: however, a very considerable number might be added to enlarge the catalogue; but having supplied a general history, the mind turns away from a subject where every object presents something formidable or loathsome to the imagination. Indeed the whole tribe resemble each other so nearly, that the history of one may almost serve for every other. They are all terrible to the imagination, all frightful to behold in their fury, and have long been considered as a race of animals between whom and man there is a natural antipathy.

OF INSECTS.

OF INSECTS IN GENERAL.

HAVING gone through the upper ranks of nature, we descend to that of insects, a subject almost inexhaustible from the number of their tribes and the variety of their appearance. Those who have professedly written on this subject seem to consider it as one of the greatest that can occupy the human mind, since it is the most pleasing in Animated Nature. "After an attentive examination," says Swammerdam, "of the nature and anatomy of the smallest as well as the largest animals, I cannot help allowing the least an equal, or perhaps a superior, degree of dignity. If while we dissect with care the larger animals, we are filled with wonder at the elegant disposition of their parts, to what a height is our astonishment raised, when we discover all these parts arranged in the least in the same regular manner! Notwithstanding the smallness of ants, nothing hinders our preferring them to the largest animals. If we consider either their unwearied diligence, their wonderful strength, or their inimitable propensity to labour. Their amazing love to their young is still more unparalleled among the larger classes. They not only daily carry them to such places as may afford them food; but if by accident they are killed, and even cut into pieces, they with the utmost tenderness will carry them away piecemeal in their arms. Who can show such an example among the large animals which are dignified with the title of perfect? Who can find an instance in any other creature that can come in competition with this?"

Such is the language of a man, who, by a long course of study, became enamoured of his subject; but to those who judge less partially, it will be found that the insect tribe, for every reason, deserve but the last and lowest rank in Animated Nature. As in mechanics the most complicated machines are required to perform the nicest operations, so in anatomy the noblest animals are most variously and wonderfully made. Of all living beings man offers the most wonderful variety in his internal conformation; quadrupeds come next, and other animals follow in proportion to their powers or their excellencies. Insects seem of all others the most imperfectly formed; from their minuteness the dissecting knife can go but a short way in the investigation; but one thing argues an evident imperfection, which is, that many of them can live a long time, though deprived of those organs which are necessary to life, in the higher ranks of nature. Many of them are furnished with lungs and a heart, like nobler animals; yet the caterpillar continues to live, though its heart and lungs, which is often the case, are entirely eaten away.

Yet it is not from their conformation alone that insects are inferior to other animals, but from their instincts also. It is true, that the ant and the bee present us with very striking instances of assiduity: but how far are theirs beneath the marks of sagacity exhibited in the hound or the stag! a bee, taken from the swarm, is totally helpless and inactive, incapable of giving the smallest variation to its instincts; it has but one single method of operating, and if put from that it can turn to no other. In the pursuits of the hound, there is something like a choice; in the labours of the bee, the whole appears like necessity or compulsion.

If insects be considered as bearing a relation to man, and as assisting him in the pleasures or necessities of life, they will, even in this respect, sink in the comparison with the larger tribes of Nature. It is true, that the bee, the silk-worm, the cochineal fly, and the cantharides, render him signal services; but how many others of this class, are either noxious or totally unserviceable to him? Even in a country like that of England, where all the noxious animals have been reduced by repeated assiduity, the insect tribes still maintain their ground, and are but too often unwelcome intruders upon the fruits of human industry. But in more uncultivated regions, their annoyance and devastations are terrible. What an uncomfortable life must the natives lead in Lapland, and some parts of America, where if a candle be lighted, the insects swarm in such abundance, as instantly to extinguish it by their numbers; where the inhabitants are obliged to smear their bodies and faces with tar, or some other composition, to protect them from the puncture of their minute enemies; where though millions are destroyed, famished millions are still seen to succeed, and to make the torture endless!

Their amazing number is also an argument of their imperfection. It is a rule that obtains through all Nature, that the nobler animals are slowly produced, and that Nature acts with a kind of dignified economy; but the meaner births are lavished in profusion, and thousands are brought forth merely to supply the necessities of the more favourite objects of Creation. Of all other productions in Nature, insects are the most numerous. Vegetables that cover the surface of the earth bear no proportion to their multitudes; and though, at first sight, herbs of the field seem to be the parts of organized Nature produced in the greatest abundance, yet upon minuter inspection, we shall find every plant supporting a number of scarcely perceptible creatures, that fill up the various stages of youth, vigour, and age, in the small compass of a few days existence.

All other animals are capable of some degree of education; their instincts may be suppressed or altered; the dog may be taught to fetch and carry; the bird to whistle a tune; and the serpent to dance; but the insect has but one invariable method of operating; no arts can turn it from its instincts; and, indeed, its life is too short for instruction, as a single season often terminates its existence.

For these reasons, the insect tribe are deservedly placed in the lowest rank of Animated Nature; and, in general, they seem more allied to the vegetables on which they feed, than to the noble classes above them. Many of them are attached to one vegetable, often to a single leaf; there they increase with the flourishing plant, and die as it decays; a few days generally fill up the measure of their contemptible lives; while the ends for which they were produced, or the pleasures they enjoyed, to us, at least, are utterly unknown.

Yet while I am thus fixing the rank of a certain class of animals, it seems necessary to define the nature of those animals which are thus degraded. Definitions in general produce little knowledge; but here, where the shades of Nature are so intimately blended, some discrimination is necessary to prevent confusion. The smallness of the animal, for instance does not constitute an insect; for then many of the lizard kind, which are not above two inches long, would come under this denomination, and if the smaller lizards, why not the crocodile? which would be a terrible insect indeed! In the same manner, smallness, with a slow creeping motion, does not determine the animal to be an insect; for, though snails might be called insects, with the same propriety the whole tribe of sea shell-fish would then have equal pretensions; and a very troublesome innovation would be brought into our language, which is already formed. Excluding such animals, therefore, from the insect tribe, we may define insects to be *little animals without red blood, bones, or cartilages, furnished with a trunk, or else a mouth, opening lengthwise, with eyes which they are incapable of covering, and with lungs which have their openings on the sides.* This definition comprehends the whole class of insects, whether with or without wings; whether in their caterpillar or butterfly state; whether produced in the ordinary method of generation, or from an animal that is itself both male and female, or from the same animal cut into several parts, and each part producing a perfect animal.

From hence it appears, that in this class of animals there are numerous distinctions, and that a general description will by no means serve for all. Almost every species has its own distinct history; and exhibits manners, appetites, and modes of propagation, peculiarly its own. In the larger ranks of existence, two animals that nearly resemble each other in form will be found to have a similar history; but here insects, almost entirely alike, in their appearance, will be often found completely dissimilar, as well in their manner of bringing forth and subsisting, as in the changes which they undergo during their short lives. Thus as this class is prolific beyond computation, so are its varieties multiplied beyond the power of description. The attempt to enumerate all the species of a fly or a moth would be exceedingly fruitless; but to give a history of all would be utterly impracticable; so various are the appetites, the manners, and the lives of this humble class of beings, that every species requires its distinct history. An exact plan, therefore of Nature's operations in this minute set of creatures is not to be expected; and yet such a general picture may be given, as is sufficient to point out the protection which Providence affords its smallest, as well as its largest, productions, and to display that admirable circulation in Nature by which one set of living creatures find subsistence from the destruction of another; and by which life is continued without a pause in every part of the Creation.

Upon casting a slight view over the whole insect tribe just when they are supposed to rouse from their state of annual torpidity, when they begin to feel the genial influence of spring, and again exhibit new life in every part of nature, their numbers and their varieties seem to exceed all the powers of calculation, and they are indeed too great for description. When we look closer, however, we shall find some striking similitudes, either in their propagation, their manners, or their form, that give us a hint for placing several of them into one description, and thus enabling us to shorten the labour of a separate history for every species. Swammerdam, Reaumur, and Linnæus, have each attempted to abridge the task of description, by throwing a number of similar animals into distinct classes, and thus making one general history serve for all. I will avail myself of their labours; and uniting their general distinctions, throw the whole class of insects into four separate distributions, giving under each the history of every species that seems to me considerable enough to deserve our notice. Thus our labour will be shortened; and the very rank in which an insect is placed, will, in some measure, exhibit a considerable part of its history.

In our cursory inspection of the insect tribe, the first animals that offer themselves are those which want wings, that appear crawling about on every plant, and on every spot of earth we regard with any degree of attention. Of these, some never attain wings at any period of their existence, but are destined to creep on the vegetable, or the spot of earth where they are stationed for their whole lives. On the contrary, others are only candidates for a more happy situation; and particularly wait their growing wings, when they may be said to arrive at their state of full perfection.

Those that never have wings, but creep about till they die, may be considered as constituting the FIRST CLASS of insects. All these, the flea and the wood-louse only excepted, are produced from an egg; and when once they break the shell, they never suffer any further change of form, but continue to grow larger till they die. Thus the louse or the spider are produced from an egg, never suffering any alteration when once they are excluded; but, like the chicken or the duck, remaining invariably the same, from their birth to their dissolution.

The SECOND ORDER of insects consists of such as have wings; but which, when produced from the egg, have those wings cased up in such a manner as not to appear. But this casing up of the wing, does not prevent the animal's running, leaping, and moving with its natural celerity; yet when the case bursts, and the wings have a power of expanding, all the animal's motions become more extensive, and it arrives at full perfection. Thus the grasshopper, the dragon fly, and the ear-wig, have their wings at first bound down; but when the skin that, like a pair of stays, kept them confined, bursts, they are then expanded, and the animal pursues the purposes for which it was produced.

The THIRD ORDER of insects is of the moth and butter-fly kind. These all have four wings, each covered with a mealy substance of various colours, which when handled, comes off upon the fingers; and, if examined by the microscope, will appear like scales, with which the wing is nicely embroidered all over. These insects also are produced in a manner peculiar to themselves. They are first hatched from an egg, from whence proceeds a caterpillar that eats, and often casts its skin; the caterpillar having divested itself for the last time, assumes a new covering, which is called a chrysalis, or the cone in the silk-worm, in which it continues hidden till it comes forth a perfect moth, or butterfly.

The FOURTH ORDER is of those winged insects which come from a worm instead of a caterpillar, and yet go through changes similar to those which moths and butterflies are seen to undergo. They are first excluded from the egg as a worm, and then become a chrysalis; in some, their wings and legs are seen; in others, the animal is quite detached from the cone in which it is concealed; but all at length break their prison, and come out perfect winged animals; some furnished with two wings and some with four. The wings of all these differ from those of the butterfly and moth kind, by not having the mealy scales which are ever found on the wings of the former. In this class we may place the numerous tribes of gnats, beetles, bees, and flies.

To these I will add, as a FIFTH ORDER, a numerous tribe lately discovered, to which naturalists have given the name of Zoophytes. These may be propagated by dissection. Some of these, though cut into a hundred parts, still retain life in each, and are endued with such a vivacious principle, that every part will in a short time become a perfect animal. They seem a set of creatures placed between animals and vegetables, and make the shade that connects Animated and Insensible Nature. To this class belong the polypus, the earth-worm, and all the varieties of the sea-nettle.

Having thus given a general distribution of insects, I will proceed to describe each class in the order I have mentioned them; beginning with insects without wings, as they more nearly resemble the higher ranks of Nature, as well in their habits as their conformation.

OF INSECTS WITHOUT WINGS

The observations of every moment furnishes us with instances of insects without wings; but the difficulty is to distinguish those which are condemned continually to lead reptile lives, from such as only wait the happy moment of transmutation. For this, nothing but a long and intimate acquaintance will suffice; but, in general, all animals resembling the flea, the louse, the spider, the bug, the wood-louse, the water-louse, and the scorpion, never acquire wings, but are produced from the egg in that form which they never change afterwards.

If we consider this class as distinct from others, we shall find them in general longer lived than the rest, and often continuing their term beyond one season, which is the ordinary period of an insect's existence. They seem also less subject to the influence of the weather; and often endure the rigours of winter without being numbed into torpidity. The whole race of moths, butterflies, bees, and flies, are rendered lifeless, by the return of cold weather; but we need not be told, that the louse, the flea, and many of these wingless creatures that seem forward to teaze mankind, continue their painful depredations the whole year round.

They come to perfection in the egg, as was said before; and it not unfrequently happens, that when the animal is interrupted in performing the offices of exclusion, the young ones burst the shell within the parent's body, and are thus brought forth alive. This not unfrequently happens with the wood-louse, and others of the kind, which are sometimes seen producing eggs, and sometimes young ones perfectly formed.

Although these creatures are perfect from the beginning, yet they are often, during their existence, seen to change their skin: this is a faculty which they possess in common with many of the higher ranks of animals, and which answers the same purposes. However tender their skins may seem to our feel, yet, if compared to the animal's strength and size, they will be found to resemble a coat of mail, or, to talk in more familiar language, the shell of a lobster. By this skin these animals are defended from accidental injuries, and particularly from the attacks of each other. Within this they continue to grow, till their bodies become so large as to be imprisoned in their own covering, and then the shell bursts, but is quickly replaced by a new one.

Lastly, these animals are endued with a degree of strength for their size, that at first might exceed credibility. Had man an equal degree of strength, bulk for bulk, with a louse or a flea, the history of Samson would be no longer miraculous. A flea will draw a chain a hundred times heavier than itself; and to compensate for this force will eat ten times its own size of provision in a single day.

OF THE SPIDER AND ITS VARIETIES.

The animal that deserves our first notice in this principal order of insects is the spider, whose manners are, of all others, the most subtle, and whose instincts are the most various. Formed for a life of rapacity, and incapable of living upon any other than insect food, all its habits are calculated to deceive and surprise; it spreads toils to entangle its prey; it is endued with patience to expect its coming; and is possessed of arms and strength to destroy it when fallen into the snare.

In this country, where all the insect tribes are kept under by human assiduity, the spiders are but small and harmless. We are acquainted with few, but the house-spider, which weaves its web in neglected rooms; the garden-spider, that spreads its toils from tree to tree, and rests in the centre; the wandering-spider, that has no abode like the rest; and the field-spider, that is sometimes seen mounting, web and all, into the clouds. These are the chief of our native spiders; which, though reputed venomous, are entirely inoffensive. But they form a much more terrible tribe in Africa and America. In those regions, where all the insect species acquire their greatest growth, where the butterfly is seen to expand a wing as broad as our sparrow, and the ant to build a habitation as tall as a man, it is not to be wondered at that the spiders are seen bearing a proportionable magnitude. In fact, the bottom of the Martinico spider's body is as large as a hen's egg, and covered all over with hair. Its web is strong, and its bite dangerous. It is happy for us, however, that we are placed at a distance from these formidable creatures, and that we can examine their history without feeling their resentment.

Every spider has two divisions in its body. The fore part, containing the head and breast, is separated from the hinder part or belly by a very slender thread, through which, however, there is a communication from one part to the other. The fore part is covered with a hard shell, as well as the legs, which adhere to the breast. The hinder part is clothed with a supple skin, beset all over with hair. They have several eyes all round the head, brilliant and acute; these are sometimes eight in number, sometimes but six; two behind, two before, and the rest on each side. Like all other insects, their eyes are immoveable, and they want eye-lids; but this organ is fortified with a transparent horny substance, which at once secures and assists their vision. As the animal procures its subsistence by the most watchful attention, so large a number of eyes was necessary to give it the earliest information of the capture of its prey. They have two pincers on the fore-part of the head, rough, with strong points, toothed like a saw, and terminating in claws like those of a cat. A little below the point of the claw there is a small hole, through which the animal emits a poison, which, though harmless to us, is sufficiently capable of instantly destroying its prey. This is the most powerful weapon they have against their enemies; they can open or extend these pincers as occasion may require; and when they are undisturbed, they suffer them to lie one upon the other, never opening them but when there is a necessity for their exertion. They have all eight legs, jointed like those of lobsters, and similar also in another respect; for if a leg be torn away, or a joint cut off, a new one will quickly grow in its place, and the animal will find itself fitted for combat as before. At the end of each leg there are three crooked moveable claws; namely, a small one, placed higher up, like a cock's spur, by the assistance of which it adheres to the threads of its web. There are two others larger, which meet together like a lobster's claw, by which they can catch hold of the smallest depressions, walking up or down the very polished surfaces, on which they can find inequalities that are imperceptible to our grosser sight. But when they walk upon such bodies as are perfectly smooth, as looking-glass or polished marble, they squeeze a little sponge, which grows near the extremity of their claws, and thus diffusing a glutinous substance, adhere to the surface until they make a second step. Besides the eight legs just mentioned, these animals have two others, which may more properly be called arms, as they do not serve to assist motion, but are used in holding and managing their prey.

Though thus formidably equipped, the spider would seldom prove successful in the capture, were it not equally furnished with other instruments to assist its depredations. As it lives wholly upon flies, and is without wings to pursue them, it is obvious they must for ever escape so impotent an adversary; but the spider is a most experienced hunter, and spreads its nets to catch those animals it is unable to pursue. The spider's web is generally laid in those places where flies are most apt to come and shelter; in the corners of rooms, round the edges of windows, and in the open air among the branches of trees. There the little animal remains for days, nay, weeks together, in patient expectation, seldom changing its situation though by no means successful.

For the purposes of making this web, Nature has supplied this animal with a large quantity of glutinous matter within its body, and five dugs or teats for spinning it into thread. This substance is contained in a little bag, and at first sight it has the resemblance of soft glue; but when examined more accurately it will be found twisted into many coils of an agate colour, and upon breaking it, the contents may be easily drawn out into threads. from the tenacity of the substance, not from those threads being already formed. Those who have seen the machine by which wire is spun, will have an idea of the manner in which this animal forms the threads of its little net, the orifices of the five teats above-mentioned, through which the thread is drawn, contracting or dilating at pleasure. The threads which we see, and appear so fine, are, notwithstanding, composed of five joined together, and these are many times doubled when the web is in formation.

When a house-spider proposes to erect a web, it first makes choice of some commodious spot, where there is an appearance of plunder and security. The animal then distils one little drop of its glutinous liquor, which is very tenacious, and then creeping up the wall, and joining its thread as it proceeds, it darts itself in a very surprising manner, as I have often observed, to the opposite place, where the other end of the web is to be fastened. The first thread thus formed, drawn tight, and fixed at each end, the spider then runs upon it backward and forward, still assiduously employed in doubling and strengthening it, as upon its force depends the strength and stability of the whole fabric. The scaffolding thus completed, the spider makes a number of threads parallel to the first, in the same manner, and then crosses them with others; the clammy substance of which they are formed, serving to bind them, when newly made, to each other. After this operation, the insect doubles and trebles the thread that borders its web, by opening all its teats at once, and secures the edges, so as to prevent the wind from blowing the work away. The edges being thus fortified, the retreat is next to be attended to; and this is formed like a funnel at the bottom of the web, where the little creature lies concealed. To this are two passages, or outlets, one above and the other below, very artfully contrived, to give the animal an opportunity of making excursions at proper seasons, of prying into every corner, and cleaning those parts which are observed to be clogged or encumbered. Still attentive to its web, the spider, from time to time, cleans away the dust that gathers round it, which might otherwise clog and incommode it: for this purpose, it gives the whole a shake with its paws; still, however, proportioning the blow so as not to endanger the fabric. It often happens also, that from the main web there are several threads extended at some distance on every side; these are, in some measure, the outworks of the fortification, which, whenever touched from without, the spider prepares for attack or self-defence. If the insect impinging be a fly, it springs forward with great agility; if, on the contrary, it be the assault of an enemy stronger than itself, it keeps within its fortress, and never ventures out till the danger be over. Another advantage which the spider reaps from this contrivance of a cell or retreat behind the web, is, that it serves for a place where the creature can feast upon its game with all safety, and conceal the fragments of those carcasses which it has picked, without exposing to public view the least trace of barbarity, that might create a suspicion in any insects that their enemy was near.

But it often happens, that the wind, or the rustling of the branches, or the approach of some large animal, destroys in a minute the labours of an age. In this case, the spider is compelled to remain a patient spectator of the universal ruin; and when the danger is passed away, it sets about repairing the calamity. For this purpose, it is furnished with a large store of the glutinous substance of which the web is made; and with this, it either makes a new web, or repairs the old one. In general, however, the animal is much fonder of mending than making, as it is furnished originally with but a certain quantity of glutinous matter, which, when exhausted, nothing can renew. The time seldom fails to come, when their reservoirs are entirely dried up, and the poor animal is left to all the chances of irretrievable necessity. An old spider is thus frequently reduced to the greatest extremity; its web is destroyed, and it wants the materials to make a new one. But as these animals have been long accustomed to a life of shifting, it hunts about to find out the web of another spider, younger and weaker than itself, with whom it ventures to engage in combat. The invader generally succeeds; the young one is driven out to make a new web, and the old one remains in quiet possession. Yet if the spider be unable to dispossess any other of its web, it then endeavours, for a while, to subsist upon accidental depredation; but in two or three months it inevitably dies of hunger.

The garden-spider seems to work in a different manner. The method with this insect is to spin a great quantity of thread, which floating in the air in various directions, happens from its glutinous quality, at last to stick to some object near it, a lofty plant or the branch of a tree. The spider only wants to have one end of the line fast, in order to secure and tighten the other. It accordingly draws the line when thus fixed, and then by passing and repassing upon it, strengthens the thread in such a manner as to answer all its intentions. The first cord being thus stretched, the spider walks along a part of it, and there fastens another, and dropping from thence, fastens the thread to some solid body below, then climbs up again and begins a third, which it fastens by the same contrivance. When three threads are thus fixed, it forms a square, or something that very nearly resembles one, and in this the animal is generally observed to reside. It often happens, however, when the young spider begins spinning, that its web becomes too buoyant, and not only the thread floats in the air, but even the little spinster. In this manner we have often seen the threads of spiders floating in the air; and what is still more surprising, the young spiders themselves attached to their own web. The reason is obvious; for as even gold itself may be so finely drawn out as to float in the air, so the finer thread of a spider is so buoyant as not only to float in the air, but also to lift the spider itself; which, like the tail of a kite, rises with its own manufacture.

The spider's web being thus completed, and fixed in a proper place, its next care is to seize and secure whatever insect happens to be caught in the toil. For this purpose, it remains for weeks and even months upon the watch, without ever catching a single fly; for the spider, like most other insects, is surprisingly patient of hunger. It sometimes happens that too strong a fly strikes itself against the web, and thus, instead of being caught, tears the net to pieces. In general, however, the butterfly or the hornet, when they touch the web, fly off again, and the spider seems no way disposed to interrupt their retreat. The large blue-bottle-fly, the ichneumon-fly, and the common meat-fly; seem to be its favourite game. When one of these strike into the toils, the spider is instantly seen alert and watchful at the mouth of its hole, careful to observe whether the fly be completely immeshed: if that be the case the spider walks leisurely forward, seizes its prey, and instantly kills it by instilling a venomous juice into the wound it makes. But if the fly be not entirely immeshed, the spider patiently waits, without appearing until its prey is fatigued by its struggles to obtain liberty; for if the ravager should appear in all his terrors while the prey is but half involved, a desperate effort might give it force enough to get free. If the spider has fasted for a long time, it then drags the fly immediately into its hole and devours it; but if there has been plenty of game, and the animal be no way pressed by hunger, it then gives the fly two or three turns in its web, so as completely to immesh it, and there leaves it impotently to struggle until the little tyrant comes to its appetite. Why the spider should at one time kill its prey, and at another suffer it to struggle in the toils for several hours together, I am not able to say; perhaps it only likes its prey newly killed, and therefore delays to put the captive to death until it is to be eaten.

It has been the opinion of some philosophers, that the spider was in itself both male and female; but Lister has been able to distinguish the sexes, and to perceive that the males were much less in size than the females. But this is not the chief peculiarity; for, different from all other animals, except the fish called the *ray*, it has its formative parts placed in the fore-arms, which have been already described.

The female generally lays from nine hundred to a thousand eggs in a season; they are of a bluish colour, speckled with black, and separated from each other by a glutinous substance, not unlike frog spawn water. These eggs are large or small in proportion to the size of the animal that produces them. In some they are as large as a grain of mustard-seed; in others they are scarcely visible. The female never begins to lay till she be two years old at the least, and her first brood is never so numerous as when she has come to her greatest maturity.

When the number of eggs which the spider has brought forth have remained for an hour or two to dry after exclusion, the little animal then prepares to make them a bag, where they are to be hatched until they leave the shell. For this purpose she spins a web four or five times stronger than that made for catching flies; and, besides, lines it on the inside by a down, which she plucks from her own breast. This bag, when completed, is as thick as paper, is smooth withinside, but rougher without. Within this they deposit their eggs; and it is almost incredible to relate the concern and industry which they bestow in the preservation of it. They stick it by means of their glutinous fluid to the end of their body; so that the animal, when thus loaded, appears as if she had one body placed behind another. If this bag be separated from her by any accident, she employs all her assiduity to stick it again in its former situation, and seldom abandons her treasure but with her life. When the young ones are excluded from their shells, within the bag, they remain for some time in their confinement, until the female, instinctively knowing their maturity, bites open their prison, and sets them free. But her parental care does not terminate with their exclusion; for she receives them upon her back during some time, until they have strength to provide for themselves, when they leave her never to return, and each begins a separate manufactory of its own. The young ones begin to spin when they can scarcely be discerned; and prepare for a life of plunder before they have strength to overcome. Indeed nature seems to have formed them in every respect for a life of hostility. No other insect is possessed of such various powers of assault and defence; and they are able to destroy animals ten times bigger than themselves. Even after a severe defeat they quickly recover of their wounds; and as for their legs they consider the loss of them as but a small misfortune, for they grow again very speedily to their former magnitude.

Thus there is no insect to which they are not an enemy; but what is more barbarous still, spiders are the enemies of each other. M. Reaumur, who was fond of making experiments upon insects, tried to turn the labours of the spider to human advantage, and actually made a pair of gloves from their webs. For this purpose he collected a large number of those insects together: he took care to have them constantly supplied with flies, and the ends of young feathers fresh picked from chickens and pigeons, which being full of blood are a diet that spiders are remarkably fond of. But notwithstanding all his care he was soon convinced that it was impracticable to rear them, since they were of such a malignant nature that they could never be brought to live in society; but instead of their usual food chose to devour each other. Indeed, were it practicable to reconcile them to each other, it would require too much attendance to rear up a sufficient number to make the project any way useful. Their thread is four, if not five times finer than that of the silk-worm; so that upon the smallest calculation there must have been sixty thousand spiders to make a single pound of silk. That which Reaumur made use of was only the web in which they deposited their eggs, which is five times stronger than that of their ordinary manufacture.

Of this animal there are several kinds, slightly differing from each other, either in habits or conformation. The water-spider is the most remarkable of the number. This insect resembles the common spider in its appearance, except that its hinder part is made rather in the shape of a nine-pin than a ball. They differ in being able to live as well by land as water; and in being capable of spinning as well in one element as the other. Their appearance under water is very remarkable; for though they inhabit the bottom, yet they are never touched by the element in which they reside, but are inclosed in a bubble of air that, like a box, surrounds them on every side. This bubble has the bright appearance at the bottom of quicksilver; and within this they perform their several functions of eating, spinning, and sleeping, without its ever bursting, or in the least disturbing their operations: sometimes the bubble is seen divided into three distinct apartments; and in the spring the male enters one of those to enjoy the company of the female, while the bubble in which he was contained unites with the other, like two drops of water, when approached to each other. They spin their webs as well in the water as upon land; and it is most probable that they make their food of the small insects of either element.

The tarantula is also of this species, and deserves particular notice, not for any remarkable properties that really attend it, but for the numerous falsehoods which have been propagated concerning it. What may be said with truth concerning it is, that it is the largest of the spider kind known in Europe, and is a native of Apulia in Italy. Its body is three quarters of an inch long, and about as thick as one's little finger; the colour is generally an olive brown, variegated with one that is more dusky; it has eight legs and eight eyes, like the rest, and nippers, which are sharp and serrated: between these and the fore legs, there are two little horns, or feelers, which it is observed to move very briskly when it approaches its prey. It is covered all over the body with a soft down, and propagates, as other spiders, by laying eggs. In the summer months, particularly in the dog days, the tarantula, creeping among the corn, bites the mowers and passengers: but in winter it lurks in holes, and is seldom seen.

Thus far is true; but now the fable begins: for though the bite be attended with no dangerous symptoms, and will easily cure of itself, wonderful stories have been reported concerning its virulence. The part which is bitten, as we are told, is soon after discoloured with a livid black, or yellowish circle, attended with an inflammation.

At first the pain is scarcely felt; but a few hours after come on a violent sickness, difficulty of breathing, fainting, and sometimes trembling. The person bit after this does nothing but laugh, dance, skip about, putting himself into the most extravagant postures, and sometimes also is seized with a most frightful melancholy. At the return of the season in which he was bit, his madness begins again; and the patient always talks of the same things. Sometimes he fancies himself a shepherd; sometimes a king; appearing entirely out of his senses. These troublesome symptoms have been said to return for several years successively, and at last terminate in death. But so dreadful a disorder has, it seems, not been left without a remedy; which is no other than a well-played fiddle. For this purpose the medical musician plays a particular tune, famous for the cure, which he begins slow, and increases in quickness as he sees the patient affected. The patient no sooner hears the music but he begins to dance; and continues so doing till he is all over in a strong perspiration, which forces out the venom that appeared so dangerous. This dancing sometimes continues for three or four hours, before the patient is weary, and before the sweating is copious enough to cure the disorder. Such are the symptoms related of the tarantula poison; symptoms which some of the best and gravest physicians have credited, and attempted to account for. But the truth is, that the whole is an imposition of the peasants upon travellers who happen to pass through that part of the country, and who procure a trifle for suffering themselves to be bitten by the tarantula. Whenever they find a traveller willing to try the experiment, they readily offer themselves, and are sure to counterfeit the whole train of symptoms which music is supposed to remove. A friend of mine, who had passed through that part of the country, had a trusty servant bitten without ever administering the musical cure: the only symptoms were a slight inflammation, which was readily removed, and no other consequence ever attended the bite. It is thus that falsehoods prevail for a century or two; and mankind at last begin to wonder how it was possible to keep up the delusion for so long a period.

OF THE FLEA.

The history of those animals with which we are the best acquainted are the first objects of our chiefest curiosity. There are few but are well informed of the agility and blood-thirsty disposition of the flea; of the caution with which it comes to the attack; and the readiness with which it avoids the pursuit. This insect, which is not only the enemy of mankind, but of the dog, cat, and several other animals, is found in every part of the world, but bites with greater severity in some countries than in others. Its numbers in Italy and France are much greater than in England; and yet its bite is much more troublesome here than I have found it in any other place. It would seem that its force increases with the coldness of the climate; and, though less prolific, that it became more predacious.

If the flea be examined with a microscope, it will be observed to have a small head, large eyes, and a roundish body. It has two feelers, or horns, which are short, and composed of four joints; and between these lies its trunk, which it buries in the skin, and through which it sucks the blood in large quantities. The body appears to be all over curiously adorned with a suit of polished sable armour, neatly jointed, and beset with multitudes of sharp pins, almost like the quills of a porcupine. It has six legs, the joints of which are so adapted, that it can, as it were, fold them up one within another; and when it leaps, they all spring out at once, whereby its whole strength is exerted, and the body raised above two hundred times its own diameter.

The young fleas are at first a sort of nits or eggs, which are round and smooth; and from these proceed white worms, of a shining pearl colour: in a fortnight's time they come to a tolerable size, and are very lively and active; but if they are touched at this time, they roll themselves up in a ball: soon after this they begin to creep like silk-worms that have no legs; and seek a place to lie hid in, where they spin a silken thread from their mouth, and with this they inclose themselves in a small round bag or case, as white within as writing-paper, but dirty without: in this they continue for a fortnight longer; after which they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor.

OF THE LOUSE AND ITS VARIETIES.

The antipathies of mankind are various; some considering the toad, some the serpent, some the spider, and some the beetle, with a strong degree of detestation; but while all wonder at the strangeness of each other's aversions, they all seem to unite in their dislike to the louse, and regard it as their natural and most nauseous enemy. Indeed it seems the enemy of man in the most odious degree; for wherever wretchedness, disease, or hunger seize upon him, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities.

In examining the human louse with the microscope its external deformity first strikes us with disgust: the shape of the fore part of the head is somewhat oblong; that of the hind part somewhat round: the skin is hard, and, being stretched, transparent, with here and there several bristly hairs: in the fore part is a proboscis or sucker, which is seldom visible; on each side of the head are antennæ, or horns, each divided into five joints, covered with bristly hair; and several white vessels are seen through these horns: behind these are the eyes, which seem to want those divisions observable in other insects, and appear encompassed with some few hairs; the neck is very short, and the breast is divided into three parts; on each side of which are placed six legs, consisting of six joints, covered also with bristly hairs; the ends of the legs are armed with two smaller and larger ruddy claws, serving those insects as a finger and thumb, by which they catch hold of such objects as they approach; the end of the body terminates in a cloven tail, while the sides are all over hairy; the whole resembling clear parchment, and, when roughly pressed, cracking with a noise.

When we take a closer view, its white veins, and other internal parts appear, as likewise a most wonderful motion in its intestines, from the transparency of its external covering. When the louse feeds the blood is seen to rush, like a torrent, into the stomach; and its greediness is so great, that the excrements contained in the intestines are ejected at the same time, to make room for this new supply.

The louse has neither beak, teeth, nor any kind of mouth, as Dr. Hooke described it; for the entrance into the gullet is absolutely closed. In the place of all these, it has a proboscis or trunk; or, as it may be otherwise called, a pointed, hollow, sucker, with which it pierces the skin, and sucks the human blood, taking that for food only. The stomach is lodged partly in the breast and back; but the greatest portion of it is in the abdomen. When swollen with blood it appears of a dark brown colour, which is visible through the skin; and is either a faint red, or a full or bright brown, as the contents of the stomach are more or less changed. When it is empty it is colourless; but when filled it is plainly discernible, and its motion seems very extraordinary. It then appears working with very strong agitations, and somewhat resembles an animal within an animal. Superficial observers are apt to take this for the pulsation of the heart; but if the animal be observed when it is sucking, it will then be found that the food takes a direct passage from the trunk to the stomach, where the remainder of the old aliment will be seen mixing with the new, and agitated up and down on every side.

If this animal be kept from food two or three days, and then placed on the back of the hand, or any soft part of the body, it will immediately seek for food; which it will the more readily find if the hand be rubbed till it grows red. The animal then turns its head, which lies between the two fore legs, to the skin, and diligently searches for some pore: when found it fixes the trunk therein; and soon the microscope discovers the blood ascending through the head, in a very rapid and even frightful stream. The louse has at that time sufficient appetite to feed in any posture; it is then seen sucking with its head downward, and its tail elevated. If, during this operation, the skin be drawn tight, the trunk is bound fast, and the animal is incapable of disengaging itself; but it more frequently suffers from its gluttony, since it gorges to such a degree, that it is crushed to pieces by the slightest impression.

Swammerdam is inclined to think that lice are hermaphrodites, having found an ovary in all those he examined; and he dissected not less than forty-two. In one of these animals were found ten large eggs; and forty-four smaller, that were not yet come to their full perfection.

There is scarcely any animal that multiplies so fast as this unwelcome intruder. It has been pleasantly said, that a louse becomes a grandfather in the space of twenty-four hours: this fact cannot be ascertained; but nothing is more true than that the moment the nit, which is no other than the egg of the louse, gets rid of its superfluous moisture, and throws off its shell, it then begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal as cold and want of humidity; the nits must be laid in a place that is warm and moderately moist to produce any thing. This is the reason that many nits laid on the hairs in the night-time, are destroyed by the cold of the succeeding day; and so stick for several months, till they at last even lose their external form.

The louse is found upon every part of the human body; but particularly in the heads of children. Those found upon the miners in Sweden are said by Linnæus to be very large; and he is of opinion that the head and the body-louse differ in no respect from each other. The pthiriasis, or lousy disease, though very little known at present, was frequent enough among the ancients: Herod, Antiochus, Epiphanes, Alcman the poet, Pherecydes, Cassander, Callisthenes, and Sylla, all died of this disorder. The use of mercury, which was unknown among the ancients, may probably have banished it from among the moderns; for certain it is, that these animals seldom attack any in our climate but such as from sloth or famine invite their company.

Such is the history of the human louse, which, from its connection with mankind, deserves first notice: but it would be endless to describe the various tribes that go under this name, and swarm upon every part of nature. There is scarcely an animal, or even a vegetable, that does not suffer under its own peculiar louse. The sheep, the horse, the hog, and the elephant, are all teased by them; the whale, the shark, the salmon, and the lobster, are not without their company; while every hot-house and every garden is infested with some peculiarly destructive. Linnæus tells us, that he once found a vegetable-louse upon some plants newly arrived from America; and, willing to trace the little animal through its various stages, he brought it with him from London to Leyden, where he carefully preserved it during the winter, until it bred in the spring; but the louse it seems did not treat him with all the gratitude he expected; for it became the parent of so numerous a progeny, that it soon over-run all the physic-garden of that beautiful city; and leaves, to this day, many a gardener to curse the Swede's too indulgent curiosity.

The animal which some have called the Leaf Louse, is of the size of a flea, and of a bright green, or bluish-green colour; the body is nearly oval, and is largest and most convex on the hinder part; the breast is very small, and the head is blunt and green: the eyes may be seen very plainly, being prominent on the fore part of the head, and of a shining black colour; near these there is a black line on each side; and the legs are very slender.

These animals are usually found upon the leaves of the orache, and other plants; and the weaker the leaves and buds are, these insects are observed to swarm upon them in greater abundance. Some plants are covered over with them; though they are not the cause of the plant's weakness, but the sign: however, by wounding and sucking the leaf, they increase the disease. They generally assume their colour from the plant on which they reside. Those that feed upon pot-herbs and plum-trees, are of an ash-colour; only they are greenish when they are young: those that belong to the alder and cherry-tree, are black; as also those upon beans, and some other plants: those on the leaves of apples and rose-trees, are white; but as they leap, like grasshoppers, some place them in the number of the flea-kind. The most uncommon colour is reddish; and lice of this sort may be found on the leaves of tansey; and their juice, when rubbed in the hands, tinges them with no disagreeable red. All these live upon their respective plant; and are often engendered within the very substance of the leaf.

All these bring forth their young alive; and the fœtus, when it is ready to be brought forth, entirely fills the belly of the female; its fore parts being excluded first, and then the hinder. The young one does not begin to move till the horns or feelers appear out of the body of the old one; and by the motion of these it first shows signs of life, moving them in every direction, and bending all their joints. When the horns and head are excluded, the two fore-feet follow, which they move with equal agility; after this follow the middle feet, and then the hinder: still, however, the young one continues sticking to its parent, supported only at one extremity, and hanging, as it were in air, until its small and soft members become hardened and fitted for self-support. The parent then gets rid of its burden; by moving from the place where she was sitting, and forcing the young one to stand upon its legs, leaves it to shift for itself.

As the animal has not far to go, its provisions lying beneath it, during the summer it continues to eat and creep about with great agility. But as it is viviparous, and must necessarily lurk somewhere in winter, where its body may be defended from the cold, it endeavours to secure a retreat, near the trees or plants that serve to nourish it in the beginning of spring. They never hide themselves in the earth, like many other insects, because they have no part of their bodies fitted to remove the earth; nor can they creep into every chink, as their legs are too long: besides, their bodies are so tender, that the least rough particle of the earth would hurt them. They, therefore, get into the deep chinks of the bark, and into the cavities of the stronger stalks, from whence they sally out upon the branches and leaves, when the warmth of the sun begins to be felt. Neither the cold in the autumnal season, nor the lesser degree of heat in the spring, ever hurts them; they seldom, therefore, seek for hiding-places before the fall of the leaf, and are alert enough to take the earliest advantage of the returning spring.

Like many other insects, they cast their skins four several times; and, what is very remarkable, the males have four wings, but the females never have any. They all have long legs, not only to enable them to creep over the long hairs of leaves of plants, but also to travel from one tree to another when they happen to stand at a distance. Their trunk or snout lies under their breast; and this they thrust into the pores of the plant to suck out the juice, for they do not gnaw them like the caterpillar; but so hurt them by sucking, that the leaves become spotted, and as it were overrun with scabs; for which reason their edges always turn up towards the middle.

It has been said, that these insects are often carried away and devoured by ants; but this Frysch, from whom this description is taken, could never observe. The ants, indeed, are fond of those trees where there is a great number of those insects; but then it is only to suck the juice which flows from the leaves that have been just wounded. This more particularly happens in the heat of summer, when other moisture is wanting: but he never found them hurting or carrying away any of these insects while alive; nor, indeed, were they able, for the leaf-louse is more than a match for the ant at single combat. Whenever they perceive the ant approaching behind them, they kick back with their hinder feet, and thus drive off the invader, as a horse would a lion.

The three principal and constant enemies to these insects are, first, the fire-fly, which lays its eggs where these insects are in greatest number, and which, producing a worm, seizes and devours all the leaf-lice that come near it: another enemy is the worm of a peculiar kind of beetle, which destroys them in great numbers; but the most formidable of all enemies, is the ichneumon fly, that seizes upon one of the largest females, and laying its egg upon her, this is hatched into a worm, which soon devours and destroys the animal from whose body it sprung.

OF THE BUG AND ITS VARIETIES.

THE bug is another of those nauseous insects that intrude upon the retreats of mankind; and that often banish that sleep, which even sorrow and anxiety permitted to approach. This, to many men, is of all other insects the most troublesome and disagreeable. The night is usually the season when the wretched have rest from their labour; but this seems the only season when the bug issues from its retreats, to make its depredations. By day it lurks, like a robber, in the most secret parts of the bed; takes the advantage of every chink and cranny, to make a secure lodgement; and contrives its habitation with so much art, that scarcely any industry can discover its retreat. It seems to avoid the light with great cunning; and even if candles be kept burning, this formidable insect will not issue from its hiding-place. But when darkness promises security, it then issues from every corner of the bed, drops from the teaster, crawls from behind the arras, and travels with great assiduity to the unhappy patient, who vainly wishes for rest and refreshment. It is generally vain to destroy one only, as there are hundreds more to revenge their companion's fate; so that the person who thus is subject to be bitten, remains the whole night like a centinel upon duty, rather watching the approach of fresh invaders, than inviting the pleasing approaches of sleep.

Nor are these insects less disagreeable from their nauseous stench, than their unceasing appetites. When they begin to crawl, the whole bed is infected with the smell: but if they are accidentally killed, then it is insupportable.

These are a part of the inconveniences that result from the persecution of these odious insects: but happily for Great Britain, they multiply less in these islands than in any part of the continent. In France and Italy the beds, particularly in their inns, swarm with them; and every piece of furniture seems to afford them a retreat. They grow larger also with them than with us, and bite with more cruel appetite.

This animal, if examined minutely, appears to consist of three principal parts; the head, the corselet, and the belly. It has two brown eyes, that are very small, and a little prominent, besides two feelers, with three joints: underneath these there is a crooked trunk, which is its instrument of torture, and which, when in motion, lies close upon the breast. The breast is a kind of ring, in which are placed the two first pair of legs. The belly consists of nine rings; under which are placed two pair of legs more, making six in all. Each leg has three joints, which form the thigh, the leg, and the foot, which is armed with a crooked claw, like a hook. The body is smooth, except a few short hairs, that may be seen by the microscope, about the vent, and on the two last rings. Its motion is slow and unwieldy; yet its sight is so exquisite, that the instant it perceives the light, it generally makes good its retreat; and they are seldom caught, though the bed swarms with them.

If we examine this insect internally, we shall find the great artery, which in all insects performs the functions of the heart; we shall find the apertures of the lungs on the right side and the left, through which the animal breathes; we shall find a stomach and intestines, which, as in other animals, run from the mouth to the anus. If the insect has been kept long fasting, there will be a mucus found in its body, like the white of an egg; but if crushed after a full meal, the human blood which it has sucked in, will appear a little darkened, by having passed through the insect's body.

The male and female of these animals are plainly distinguishable from each other. The female has an ovary filled with eggs, joined together like a bunch of grapes; each egg being oblong, almost cylindrical, inclining to white, and pretty transparent. In about two days after impregnation, she deposits her eggs to the number of about a hundred and fifty, in some convenient place where they are likely to receive no disturbance. There they continue for some months; during which time, neither cold nor heat, neither moisture nor fumigation, can in the least retard their exclusion; but they come forth active, and ready for mischief. It is this hardiness in the shell that seems to continue the breed; as the old ones die every winter, or are easily destroyed by any fumigation that is used for that purpose. But the eggs seem incapable of destruction; even those men who make a livelihood by killing these nauseous insects, though they can answer for the parent, can never be sure of the egg. For this reason they usually pay those houses to which they are called a second or a third visit, and at last exterminate them by perseverance.

The manner of destroying them seems rather the effects of assiduity than antidote; for the men called in upon this occasion, take every part of the furniture asunder, brush every part of it with great assiduity, anoint it with a liquid which I take to be a solution of corrosive sublimate, and having performed this operation twice or thrice, the vermin are most usually destroyed.

Cleanliness, therefore, seems to be the best antidote to remove these nauseous insects; and wherever that is wanting, their increase seems but a just punishment. Indeed, they are sometimes found in such numbers among old furniture, and neglected chambers, exposed to the south, that, wanting other sustenance, they devour each other. They are also enemies to other vermin, and destroy fleas very effectually; so that we seldom have the double persecution of different vermin in the same bed. Of the bug kind Linnæus reckons up forty.

OF THE WOOD-LOUSE AND ITS VARIETIES.

The common wood-louse is seldom above half an inch long, and a quarter of an inch broad. The colour is of a livid black, especially when found about dunghills, and on the ground; but those that are to be met with under tiles, and in drier places, are of the colour of the hair of an ass. It has fourteen feet, seven on each side; and they have only one joint each, which is scarcely perceptible. It has two short feelers, and the body is of an oval shape. When touched it rolls itself up into a sort of a ball; and the sides near the feet are dentated like a saw. It is often found among rotten timber, and on decayed trees; in winter it lies hid in the crevices of walls and all sorts of buildings. The male is easily distinguishable from the female, being less and more slender. The eggs they lay are white and shining, like seed pearls, and very numerous: but more properly speaking, although when excluded the young have all the appearance of an egg, yet they are alive, and without throwing off any shell, stir and move about with great vivacity; so that this animal may properly be said to be viviparous. The little worms at first seem scarcely able to stir; but they soon feed, and become very brisk. These animals are of great use in medicine, being impregnated with a saline quality, which is diuretic and stimulating. Of this insect Linnæus makes three species.

OF THE MONOCULUS, OR ABORESCENT WATER-FLEA.

This animal, which is of the size of a flea, appears to the sight, unassisted by the microscope, to have but one eye; for the eyes, by reason of the smallness of the head, seem to be joined to each other: they are situated in the trunk of this insect, and the beak is likewise very small and sharp-pointed. The structure of the eye is perceived by the microscope to be reticulated, or made like a net; and the trunk of this insect, by which it feeds, is not only small and sharp, but also transparent. The insects are of a blood red colour; and sometimes are seen in such multitudes on the surface of standing water, as to make it appear all over red, whence many fanciful people have thought the water to be turned into blood.

Swammerdam tells us of a celebrated professor of Leyden, who was at first astonished by an appearance of this kind. Being once intent upon his studies, he heard a noise, of which, as it increased by degrees, he was desirous to know the cause. The maid-servant, attending to his summons, appeared quite petrified with fear, and told him with a tremulous voice, that all the waters of Leyden were turned into blood! Upon this he went directly in a small bark to the place where the water was thus changed, and put some of the bloody water into a glass; but upon viewing it with attention, he observed, that it abounded with infinite numbers of these little red insects, which tinged the whole body of the fluid with that seemingly formidable colour. Thus his sudden fright was changed into lasting admiration.

Of all parts of this animal, its branching arms, and the motion it makes with them in the water, deserve our greatest attention. By these the little creature can move in a straight line; waving its arms, as a bird does its wings in the air, sometimes upward, sometimes downward, sometimes to the right, sometimes to the left, yet still continuing to proceed in a right line. By striking the water with its arms it can ascend with great velocity; and by striking in a contrary direction it dives with equal ease. These motions being very rapid, the little animal appears to jump in the water, its head always tending to the surface, and its tail stretched downward. This insect is produced from an egg, which, when excluded, is carried on the back of the female, and soon is seen floating in the water round her. Its appearance at first is that of a very small whitish insect, endued with a very nimble motion. Except in colour it undergoes no change, only continuing to grow larger and redder as it grows older. They sometimes remain several days on the surface of the water; and sometimes are seen at the bottom only; but they are never at rest. They change their skin, like most other insects; and the cast skin resembles the insect itself so exactly, that one might easily mistake the mask for the animal.

OF THE SCORPION AND ITS VARIETIES.

There is scarcely an insect without wings that is not disagreeable to man: the smallest have the power of annoying him, either by biting or stinging him; and though each is in itself contemptible, they become formidable from their numbers. But of all this class there is none so terrible as the scorpion, whose shape is hideous, whose size among the insect tribe is enormous, and whose sting is generally fatal. Happy for England the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but too well known, though it seldom grows above four inches long: but in the warm tropical climates it is seen a foot in length, and in every respect as large as a lobster.

The scorpion is one of the largest of the insect tribe, and not less terrible from its size than its malignity. It resembles a lobster somewhat in shape, but is infinitely more hideous. There have been enumerated nine different kinds of this dangerous insect, chiefly distinguished by their colour, there being scorpions yellow, brown, and ash-coloured; and there are others that are the colour of rusty iron, green, pale yellow, black, claret-colour, white, and grey.

There are four principal parts distinguishable in this animal; the head, the breast, the belly, and the tail. The scorpion's head seems, as it were, jointed to the breast; in the middle are seen two eyes; and a little more forward, two eyes more, placed in the fore part of the head: these eyes are so small, that they are scarcely perceivable; and it is probable the animal has but little occasion for seeing. The mouth is furnished with two jaws; the undermost is divided into two, and the parts notched into each other, which serve the animal for teeth, and with which it breaks its food, and thrusts it into its mouth: these the scorpion can at pleasure pull back into its mouth, so that no part of them can be seen. On each side of the head are two arms, each composed of four joints; the last of which is large, with strong muscles, and made in the manner of a lobster's claw. Below the breast are eight articulated legs, each divided into six joints; the two hindmost of which are each provided with two crooked claws, and here and there covered with hair. The belly is divided into seven little rings; from the lowest of which is continued a tail composed of six joints, which are bristly and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable: it is long, pointed, hard, and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and fatal. The reservoir in which this poison is kept, is in a small bladder near the tail, into which the venom is distilled by a peculiar apparatus. If this bladder be gently pressed, the venom will be seen issuing out through the two holes above-mentioned; so that it is evident, that when the animal stings, the bladder is pressed, and the venom issues through the two apertures into the wound.

There are few animals more formidable, or more truly mischievous than the one we are describing. As it takes refuge in a small place, and is generally found sheltering in houses, so it cannot be otherwise than that it must frequently sting those among whom it resides. In some of the towns of Italy, and in France, in the province of Languedoc, it is one of the greatest pests that torment mankind: but its malignity in Europe is trifling, when compared to what the natives of Africa and the east are known to experience. In Batavia, where they grow twelve inches long, there is no removing any piece of furniture, without the utmost danger of being stung by them. Bosman assures us, that, along the Gold Coast, they are often found larger than a lobster; and that their sting is inevitably fatal. In Europe, however, they are by no means so large, so venomous, nor so plentiful The general size of this animal does not exceed two or three inches; and its sting is very seldom found to be attended with fatal consequences. Maupertuis, who made several experiments on the scorpion of Languedoc, found it by no means so invariably dangerous as had till then been represented. He provoked one of them to sting a dog, in three places of the belly, where the animal was without hair: in about an hour after, the poor animal seemed greatly swollen, and became very sick; he then cast up whatever he had in his bowels; and for about three hours continued vomiting a whitish liquid. The belly was always greatly swollen, when the animal began to vomit; but this operation always seemed to abate the swelling; which alternately swelled, and was thus emptied, for three hours successively. The poor animal, after this, fell into convulsions, bit the ground, dragged himself along upon his fore feet, and at last died, five hours after being bitten. He was not partially swollen round the place which was bitten, as is usual after the sting of a wasp or a bee; but his whole body was inflated, and there only appeared a red spot on the places where he had been stung.

Some days after, however, the same experiment was tried upon another dog, and even with more aggravated cruelty; yet the dog seemed no way affected by the wounds, but howling a little when he received them, continued alert and well after them; and soon after was set at liberty, without showing the smallest symptoms of pain. So far was this poor creature from being terrified at the experiment, that he left his own master's house, to come to that of the philosopher, where he had received more plentiful entertainment. The same experiment was tried by fresh scorpions, upon seven other dogs, and upon three hens; but not the smallest deadly symptoms were observed to ensue. From hence it appears that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion's venom. Whether its food, long fasting, the season, the nature of the vessels it wounds, or its state of maturity, contribute to, or retard its malignity, is yet to be ascertained by succeeding experiment. In the trials made by our philosopher, he employed scorpions of both sexes, newly caught, and seemingly vigorous and active. The success of this experiment may serve to show that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. They only happened to cure, when their sting was no way dangerous; but in cases of actual malignity, they might probably be utterly unserviceable.

The scorpion of the tropical climates being much larger than the former, is probably much more venomous. Helbigius, however, who resided for many years in the East, assures us, that he was often stung by the scorpion, and never received any material injury from the wound: a painful tumour generally ensued; but he always cured it by rubbing the part with a piece of iron or stone, as he had seen the Indians practise before him, until the flesh became insensible. But Seba, Moore, and Bosman, give a very different account of the scorpion's malignity; and assert that, unless speedily relieved, the wound becomes fatal.

It is certain that no animal in the creation seems endued with such an irascible nature. I have often seen them taken and put into a place of security, exerting all their rage against the sides of the glass vessel that contained them. I have seen them attempt to sting a stick when put near them; and attack a mouse or a frog, while those animals were far from offering any injury. Maupertuis put three scorpions and a mouse into the same vessel together, and they soon stung the little animal in different places. The mouse, thus assaulted, stood for some time upon the defensive, and at last killed them all, one after another. He tried this experiment, in order to see, whether the mouse, after it had killed, would eat the scorpions; but the little quadruped seemed entirely satisfied with the victory, and even survived the severity of the wounds it had received: Wolkamer tried the courage of the scorpion against the large spider, and inclosed several of both kinds in glass vessels for that purpose. The success of this combat was very remarkable. The spider at first used all its efforts to immesh the scorpion in its web, which it immediately began spinning; but the scorpion rescued itself from the danger by stinging its adversary to death; it soon after cut off with its claws all the legs of the spider, and then sucked all the internal parts at its leisure. If the scorpion's skin had not been so hard, Wolkamer is of opinion that the spider would have obtained the victory; for he had often seen one of these spiders destroy a toad.

The fierce spirit of this animal is equally dangerous to its own species; for scorpions are the most cruel enemies to each other. Maupertuis put about a hundred of them together in the same glass; and they scarcely came into contact when they began to exert all their rage in mutual destruction; there was nothing to be seen but one universal carnage, without any distinction of age or sex; so that in a few days there remained only fourteen, which had killed and devoured all the rest.

But their unnatural malignity is still more apparent in their cruelty to their offspring. He enclosed a female scorpion in a glass vessel, and she was seen to devour her young as fast as they were excluded; there was but one only of the number that escaped the general destruction by taking refuge on the back of its parent; and this soon after revenged the cause of its brethren by killing the old one in its turn.

Such is the terrible and unrelenting nature of this insect, which neither the bonds of society, nor of nature, can reclaim; it is even asserted, that when driven to an extremity the scorpion will often destroy itself. The following experiment was ineffectually tried by Maupertuis: but I am so well assured of it by many eye-witnesses, who have seen it both in Italy and America, that I have no doubt remaining of its veracity: A scorpion, newly caught, is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side; the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping; but finding that impossible, it stings itself on the back of the head, and in this manner the undaunted suicide instantly expires.

It is happy for mankind that these animals are thus destructive to each other; since otherwise they would multiply in so great a degree as to render some countries uninhabitable. The male and female of this insect are very easily distinguishable; the male being smaller and less hairy. The female brings forth her young alive, and perfect in their kind. Rhedi, having bought a quantity of scorpions, selected the females, which by their size and roughness were easily perceivable from the rest, and putting them in separate glass vessels he kept them for some days without food. In about five days one of them brought forth thirty-eight young ones, well shaped, and of a milk-white colour, which changed every day more and more into a dark rusty hue. Another female, in a different vessel, brought forth twenty-seven of the same colour: and the day following the young ones seemed all fixed to the back and belly of the female. For near a fortnight all these continued alive and well; but afterwards some of them died daily: until, in about a month, they all died except two.

Were it worth the trouble, these animals might be kept living as long as curiosity should think proper. Their chief food is worms and insects; and upon a proper supply of these their lives might be lengthened to their natural extent. How long that may be we are not told; but if we may argue from analogy it cannot be less than seven or eight years; and perhaps in the larger kind double that duration. As they have somewhat the form of a lobster, so they resemble that animal in casting their shell, or more properly their skin; since it is softer by far than the covering of the lobster, and set with hairs, which grow from it in great abundance, particularly at the joinings. The young lie in the womb of the parent, each covered up in its own membrane, to the number of forty or fifty, and united to each other by an oblong thread, so as to exhibit altogether the form of a chaplet.

Such is the manner in which the common scorpion produces its young; but there is a scorpion of America, produced from the egg, in the manner of the spider. The eggs are no larger than pin-points; and they are deposited in a web which they spin from their bodies, and carry about with them till they are hatched. As soon as the young ones are excluded from the shell, they get upon the back of the parent, who turns her tail over them, and defends them with her sting. It seems probable, therefore, that captivity produces that unnatural disposition in the scorpion, which induces it to destroy its young; since, at liberty, it is found to protect them with such unceasing assiduity.

OF THE SCOLOPENDRA AND GALLY-WORM.

Of these hideous and angry insects we know little, except the figure and the noxious qualities. Though with us there are insects somewhat resembling them in form, we are placed at a happy distance from such as are really formidable. In England they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard.

The scolopendra is otherwise called the centipes, from the number of its feet; and it is very common in many parts of the world, especially between the tropics. Those of the East Indies, where they grow to the largest size, are about six inches long, of a ruddy colour, and as thick as a man's finger: they consist of many joints; and from each joint is a leg on each side: they are covered with hair, and seem to have no eyes; but there are two feelers on the head, which they make use of to find out the way they are to pass: the head is very round, with two small sharp teeth, with which they inflict wounds that are very painful and dangerous. A sailor that was bit by one on board a ship felt an excessive pain, and his life was supposed to be in danger: however, he recovered by the application of three roasted onions to the part, and was soon quite well. Of this animal there are different kinds; some living, like worms, in holes in the earth; others under stones, and among rotten wood: so that nothing is more dangerous than removing those substances, in the places where they breed.

The gally-worm differs from the scolopendra, in having twice the number of feet; there being two on each side, to every joint of the body. Some of these are smooth, and others hairy; some are yellow, some black, and some brown. They are found among decayed trees, between the wood and the bark; as also among stones that are covered with moss. They all, when touched, contract themselves, rolling themselves up like a ball. Whatever may be their qualities in the tropical parts of the world, in Europe they are perfectly harmless; having been often handled and irritated, without any vindictive consequences.

All these, as well as the scorpion, are supposed to be produced perfect from the parent, or the egg; and to undergo no changes, after their first exclusion. They are seen of all sizes; and this is a sufficient inducement to suppose, that they preserve their first appearance, through the whole of their existence. It is probable, however, that like most of this class, they often change their skins; but of this we have no certain information.

OF THE LEECH.

The last of this wingless tribe that I shall mention is the leech, which, like all the former, undergoes no varieties of transformation; but when once excluded from the body of the parent, preserves its first figure to the end. I place the history of the leech among the first class of animals; while I have degraded the earth-worm, the tænia, and the polypus, into the class of zoophytes, or that imperfect tribe which serves to make the shade between animal and vegetable Nature. Not but that the earth-worm or the polypus have their motions, their appetites, and their vital principles, as complete as the leech, and, to a cursory view, appear every way as complete animals. But there is one circumstance that lays the line between them; that exalts the one and degrades the other. The earth-worm and the polypus may be cut in two pieces, and each piece will produce a new and perfect animal: the leech cannot suffer this dissection, but dies when cut in two; an evident instance that it is possessed of a more perfect organization than those animals which it otherwise very much resembles.

The leech, from its uses in medicine, is one of those insects that man has taken care to provide; but of a great variety, one kind only is considered as serviceable. The horse-leech, which is the largest of all, and grows to four inches in length, with a glossy, black surface, is of no use, as it will not stick to the skin; the snail-leech is but an inch in length; and though it will stick, is not large enough to extract a sufficient quantity of blood from the patient; the broad-tailed leech, which grows to an inch and a half in length, with the back raised into a sort of ridge, will stick but on very few occasions: it is the large brown leech, with a whitish belly, that is made use of in medicine, and whose history best merits our attention.

The leech has the general figure of a worm, and is about as long as one's middle finger. Its skin is composed of rings, by means of which it is possessed of its agility, and swims in water. It contracts itself, when out of water, in such a manner, that when touched it is not above an inch long.—It has a small head, and a black skin, edged with a yellow line on each side, with some yellowish spots on the back. The belly also, which is of a reddish colour, is marked with whitish yellow spots. But the most remarkable part of this animal is the mouth, which is composed of two lips, that take whatever form the insect finds convenient. When at rest, the opening is usually triangular; and within it are placed three very sharp teeth, capable of piercing not only the human skin, but also that of a horse or an ox. Still deeper in the head, is discovered the tongue, which is composed of a very strong fleshy substance, and which serves to assist the animal in sucking, when it has inflicted its triple wound; for no sooner is this voracious creature applied to the skin, than it buries its teeth therein, then closes its lips round the wound which it has made; and thus, in the manner of a cupping-glass, extracts the blood as it flows to the different orifices.

In examining this animal's form farther towards the tail, it is seen to have a gullet and an intestinal canal, into which the blood flows in great abundance. On each side of this are seen running along several little bladders, which, when the animal is empty, seem to be filled with nothing but water; but when it is gorging blood, they seem to communicate with the intestines, and receive a large portion of the blood which flows into the body. If these bladders should be considered as so many stomachs, then every leech will be found to have twenty-four. But the most extraordinary circumstance in this animal's formation is, that though it takes so large a quantity of food, it has no passage to eject it from the body when it has been digested. On the contrary, the blood which the leech has thus sucked remains for several months clotted within its body, blackened a little by the change, but no way putrified, and very little altered in its texture or consistence. In what manner it passes through the animal's body, or how it contributes to its nourishment, is not easily accounted for. The water in which they are kept is very little discoloured by their continuance; they cannot be supposed to return the blood by the same passage through which it was taken in: it only remains, therefore, that it goes off through the pores of the body, and that these are sufficiently large to permit its exclusion.

It is not in this instance alone, however, that the leech differs from all other insects. It has already been remarked, that the whole insect tribe had the opening into their lungs placed in their sides, and that they breathed through those apertures as other animals through the mouth. A drop of oil poured on the sides of a wasp, a bee, or a worm, would quickly suffocate them, by stopping up the passages through which they breathe; but it is otherwise with the leech, for this animal may be immersed in oil without injury; nay, it will live therein; and the only damage it will sustain is, that, when taken out, it will be seen to cast a fine pellucid skin exactly of the shape of the animal, after which it is as alert and vigorous as before. It appears from hence that the leech breathes through the mouth; and, in fact, it has a motion that seems to resemble the act of respiration in more perfect animals: but concerning all this we are very much in the dark.

This animal seems to differ from all others in several respects: the rest of the reptile tribe are brought forth from eggs; the leech is viviparous, and produces its young one after the other, to the number of forty or fifty at a birth. It is probable that, like the snail, each insect contains the two sexes, and that it impregnates and is impregnated in the same manner. The young ones are chiefly found in the month of July, in shallow running waters, and particularly where they are tepified by the rays of the sun. The large ones are chiefly sought after; and being put into a glass vessel filled with water, they remain for months, nay for years, without taking any other subsistence. But they never breed in this confinement; and, consequently, what regards that part of their history still remains obscure.

In this part of the world they seldom grow to above four inches; but in America and the East they are found from six to seven. Their pools there abound with them in such amazing numbers, that it would be dangerous bathing there, if for no other consideration. Our sailors and soldiers, who the last war were obliged to walk in those countries through marshy grounds, talk with terror of the number of leeches that infested them on their march. Even in some parts of Europe they increase so as to become formidable. Sedelius, a German physician, relates, that a girl of nine years old, who was keeping sheep near the city of Bomst in Poland, perceiving a soldier making up to her, went to hide herself in a neighbouring marsh among some bushes; but the number of leeches was so great in that place, and they stuck to her so close, that the poor creature expired from the quantity of blood which she lost by their united efforts. Nor is this much to be wondered at, since one of those insects that, when empty, generally weighs but a scruple, will, when gorged, weigh upwards of two drachms.

When leeches are to be applied, the best way is to take them from the water in which they are contained about an hour before, since they thus become more voracious and fasten more readily. When saturated with blood, they generally fall off themselves; but if it be thought necessary to take them from the wound, care should be used to pull them very gently, or even to sprinkle them with salt if they continue to adhere: for if they be plucked rudely away, it most frequently happens that they leave their teeth in the wound, which makes a very troublesome inflammation, and is often attended with danger. If they be slow in fixing to the part, they are often enticed by rubbing it with milk or blood, or water mixed with sugar. As salt is a poison to most insects, many people throw it upon the leech when it has dropped from the wound, by which means it disgorges the blood it has imbibed, and it is then kept for repeated application. They seldom, however, stick after this operation; and as the price is but small, fresh leeches should always be applied whenever such an application is supposed to be necessary.

INSECTS OF THE SECOND ORDER.

OF THE SECOND ORDER OF INSECTS IN GENERAL.

In the former part we gave a concise history of the most considerable insects that, without wings, were produced in a perfect state; either from the body of the parent alive, like quadrupeds, or from the egg, in the manner of birds. We now come to a second order of insects, that are produced from the egg, like the former, but not in a perfect state; for when first excluded they are without wings. But this does not hinder the exercise of their animal functions; the insect, although not yet arrived at perfection, walks, leaps, and eats; nor is it ever deprived of motion, except that it rests a little when it is about to cast that part of its skin previous to its state of perfection. It is then observed to assume two wings, which, like a budding flower, burst through the cage that contained them, and the animal becomes a winged insect in its state of highest perfection. To this order we may refer the libella or dragon-fly, the formica leo or lion-ant, the grasshopper, the locust, the cricket, the wood-cricket, the mole-cricket, the flea-locust, the flying-bug, the tipula, the water-scorpion, the notonecta or water-fly, and many others.

OF THE LIBELLA, OR DRAGON FLY.

Of all the flies which adorn or diversify the face of nature, these are the most various and the most beautiful; they are of all colours; green, blue, crimson, scarlet, white; some unite a variety of the most vivid tints, and exhibit in one animal more different shades than are to be found in the rainbow. They are called in different parts of the kingdom by different names; but none can be at a loss to know them, as they are distinguished from all other flies by the length of their bodies, by the largeness of their eyes, and the beautiful transparency of their wings, which are four in number. They are seen in summer flying with great rapidity near every hedge, and by every running brook; they sometimes settle on the leaves of plants, and sometimes keep for hours together on the wing.

Though there are three or four different kinds of dragon-flies, yet they all agree in the most striking parts of their history, and one account may serve for all. The largest sort are generally found from two to three inches long; their tail is forked; the body divided into eleven rings; their eyes are large, horny, and transparent, divided by a number of intersections; and their wings, that always lie flat when they are at rest, are of a beautiful glossy transparency: sometimes shining like silver, and sometimes glistening like gold. Within the mouth are to be seen two teeth covered with a beautiful lip; with these the creatures bite fiercely when they are taken; but their bite is perfectly harmless, as I have experienced more than once.

These insects, beautiful as they are, are produced from eggs, which are deposited in the water, where they remain for some time without seeming life or motion. They are ejected by the female into the water in clusters, like a bunch of grapes, where they sink to the bottom by their natural weight, and continue in that state till the young ones find strength enough to break the shell, and to separate from each other. The form in which they first exhibit life is that of a worm with six legs, bearing a strong resemblance to the dragon-fly in its winged state, except that the wings are yet concealed within a sheath peculiar to this animal. The rudiments of these appear in bunches on the back, within which the wings are folded up into each other, while all the colours and varieties of painting appear transparent through the skin. These animals, upon quitting the egg, still continue in the water, where they creep, and swim, but do not move swiftly. They have likewise a sharp sight, and immediately sink to the bottom, if any one approaches the places wherein they live, or whenever they perceive the least uncommon object. Their food at that time is soft mud, and the glutinous earthy substances that are found at the bottom.

When these animals prepare to change from their reptile to their flying state, they then move out of the water to a dry place; as into grass; to pieces of wood, stone, or any thing else they meet with. They there firmly fix their acute claws; and for a short space of time continue quite immoveable, as if meditating on the change they are to undergo. It is then observed, that the skin first opens on the head and back; and out of this opening they exhibit their real head and eyes, and at length their six legs, whilst in the mean time the hollow and empty skin, or slough of their legs, remains firmly fixed in its place. After this the enclosed creature creeps forward by degrees; and by this means draws first its wings and then its body out of the skin; and proceeding a little farther, sits at rest for some time, as if immoveable. During this period the wings, which were moist and folded, began by degrees to expand themselves, and to make smooth and even all those plaits which were laid against each other, like a closed fan. The body is likewise insensibly extended, until all the limbs have obtained their proper size and dimensions. All these surprising and difficult operations are accomplished by the force of the blood and the circulating humours. The creature cannot at first make use of its new wings, and therefore is forced to stay in the same place until all its limbs are dried by the circumambient air. But it soon begins to enter upon a more noble life than it had hitherto led in the bottom of the brook; and from creeping slowly and living accidentally, it now wings the air, and makes choice from amidst the variety of its provisions.

Indeed no animal is more amply fitted for motion, subsistence, and enjoyment. As it haunts and seeks after its food flying in the air, Nature has provided it with two large eyes, which make almost the whole head, and which resemble glittering mother-of-pearl. It has likewise four expansive silver-coloured wings, with which, as with oars, it can turn itself with prodigious velocity; and to assist these, it is furnished with a very long body, which, like a rudder, directs its motions. As the wings are long, and the legs short, they seldom walk, but are ever seen either resting or flying. It is for this reason that they always choose dry branches of trees or shrubs to remain on; and when they have refreshed themselves a little, they renew their flight. Thus they are perceived adorning the summer with a profusion of beauty, lightly traversing the air in a thousand directions, and expanding the most beautiful colours to the sun. The garden, the forest, the hedges, and the rivulets, are animated by their sports; and there are few who have been brought up in the country, who have not employed a part of their childhood in the pursuit.

But while these beautiful flies appear to us so idly and innocently employed, they are in fact the greatest tyrants of the insect tribe; and, like the hawk among birds, are only hovering up and down to seize their prey. They are the strongest and the most courageous of all winged insects; nor is there one, how large soever, that they will not attack and devour. The blue-fly, the bee, the wasp, and the hornet, make their constant prey; and even the butterfly, that spreads so large a wing, is often caught and treated without mercy. Their appetite seems to know no bounds; they spend the whole day in the pursuit, and have been seen to devour three times their own size in the capture of a single hour. They seize their prey flying with their six claws, and tear it easily to pieces with their teeth, which are capable of inflicting troublesome wounds.

But the males are upon the wing for another purpose beside that of food, as they are very salacious, and seek the females with great ardour. The sun no sooner begins to warm the fields, than the males are found assiduously employed each in seeking its mate; and no sooner does a female appear, but two or three males are seen pursuing and endeavouring to seize her with all their arts and agility. As soon as he perceives the female, and finds himself sufficiently near, he seizes upon the back of her head by surprise, and fastening his claws upon her, turns round his forky tail, which he fastens round her neck, and in this manner fixes himself so closely and firmly, that no efforts can remove him. It is in vain that she flies from one branch to another, and settles upon them, he still keeps fixed, and often continues in this situation for three or four hours successively. When he flies, she is obliged to fly with him; but he still directs the way: and though she moves her wings, she seems entirely guided by his motions. An hour or two after this, she flies to some neighbouring pool, where she deposits her eggs, as was mentioned above. There they continue in a reptile state for a year; and then are changed into a beautiful fly, resembling the parent.

OF THE FORMICA LEO, OR LION-ANT.

Although this animal properly belongs to no order of insects, yet as it is changed into a fly very much resembling that described in the preceding chapter, it may not be improper to give its history here. If we consider the life of this animal, in its different stages of existence, we shall find it equally wonderful in all: but as it changes to a dragon-fly, what we have said of that animal above, need not be repeated here. The lion-ant, when it becomes an inhabitant of air, in every respect resembles that which has been already described; its glossy wings, its voracious appetites, its peculiar manner of fecundation, are entirely the same. It is in its reptile state that it differs from all other insects; and in that state it will be amusing to pursue its history.

The lion-ant, in its reptile state, is of the size of a common wood-louse, but somewhat broader. It has a pretty long head and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty grey, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast, and two to the neck. The head is small and flat, and before there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, by which it can see the smallest object, as is easily discovered by its starting from every thing that approaches.

To a form so unpromising, and so ill provided for the purposes of rapacity, this animal unites the most ravenous appetites in Nature; but to mark its imbecility still stronger, as other animals have wings or feet to enable them to advance towards their prey, the lion-ant is unprovided with such assistance from either. It has legs, indeed; but these only enable it to run backward, so that it could as soon die as make the smallest progressive motion. Thus famished and rapacious as it ever seems, its prey must come to it, or rather into the snare provided for it, or the insidious assassin must starve.

Nature, however, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose, it chooses a dry sandy place at the foot of a wall, or under some shelter, in order to preserve its machinations from the rain. The driest and most sandy spot is the most proper for it; because a heavy clogged earth would defeat its labour. When it goes about to dig the hole where it takes its prey, it begins to bend the hinder part of its body, which is pointed, and thus works backward; making, after several attempts, a circular furrow, which serves to mark out the size of the hole it intends making, as the ancients marked out the limits of a city with the plough. Within this first furrow it digs a second, then a third, and afterwards others which are always less than the preceding. Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns or feelers towards the edges, as we see men throw up sand in a gravel-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edges of the pit, until the whole is quite completed. This hole is always formed in a perfect circle; and the pit itself resembles the inside of an inverted funnel. When this insect first leaves the egg and is newly hatched, the first pit it makes is very small; but as it grows bigger, it makes a larger hole; which is destined, like a pit-fall, to entrap its prey. It is generally about two inches deep, and as much in diameter.

The work being thus, with great labour, finished, the insidious insect places itself in ambush, hiding itself at the bottom, under the sand, in such a manner, that its two horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials; so that scarcely any insect can climb up that has once got down to the bottom. Conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If then, by misfortune, an ant, a wood-louse, or a small caterpillar walks too near the edge of the precipice, the sand gives way beneath them, and they fall to the bottom of the pit, where they meet inevitable destruction. The fall of a single grain of sand gives the murderer notice at the bottom of its cave; and it never fails to sally forth to seize upon its prey. It happens sometimes, however, that the ant or the wood-louse is too nimble, and runs up the sides of the pit-fall before the other can make ready to seize it. The lion-ant has then another contrivance, still more wonderful than the former; for, by means of its broad head and feelers, it has a method of throwing up a shower of sand which falls upon the struggling captive with tremendous weight, and once more crushes it down to the bottom. When the insect is once fallen thus low, no efforts can retrieve or release it; the lion-ant seizes it with its feelers, which are hollow, and darting them both into its body, sucks out all the little animal's juices with the utmost rapacity.

The prey being thus reduced to a husk, and nothing but the external form remaining, the next care of the murderer is to remove the body from its cell; since the appearance of dead carcases might forewarn other insects of the danger of the place. The insect, therefore, takes up the wasted trunk with its feelers, and throws it, with wonderful strength, at least six inches from the edge of its hole; and then patiently sets about mending the breaches which its fortifications had received in the last engagement. Nothing can abate its industry, its vigilance, its patience, or its rapacity. It will work for a week together to make its pit-fall; it will continue upon the watch for more than a month, patiently expecting the approach of its prey; and if it should arrive in greater quantities than is needful, yet still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to kill and attack any other that happens to fall within the sphere of its malignity: though so voracious, it is surprisingly patient of hunger; some of them having been kept in a box with sand, for six months and upwards, without any kind of food.

When the lion-ant attains a certain age, in which it is to change into another form, it then leaves off its usual rapacious habits, but still carries on its industry. It no longer continues to make pits, but furrows up the sand all round in an irregular manner; testifying those workings and violent agitations which most insects exhibit previous to their transformation. These animals are produced in autumn, and generally live a year, and perhaps two, before they assume a winged form. Certain it is, that they are found at the end of winter of all sizes; and it would seem that many of the smaller kinds had not yet attained sufficient maturity for transformation. Be this as it may, when the time of change approaches, if the insect finds its little cell convenient, it seeks no other; if it is obliged to remove, after furrowing up the sand, it hides itself under it, horns and all.—It there spins a thread, in the manner of the spider; which being made of a glutinous substance, and being humid from the moisture of its body, sticks to the little particles of sand among which it is spun; and in proportion as it is thus excluded, the insect rolls up its web, sand and all, into a ball, of which itself is the centre. This ball is about half an inch in diameter; and within it the insect resides, in an apartment sufficiently spacious for all its motions. The outside is composed of sand and silk; the inside is lined with silk only, of a fine pearl-colour, extremely delicate, and perfectly beautiful. But though the work is so curious within, it exhibits nothing to external appearance, but a lump of sand; and thus escapes the search of birds that might otherwise disturb the inhabitant within.

In this manner the insect continues shut up for six weeks or two months; and gradually parts with its eyes, its feelers, its feet, and its skin; all which are thrust into a corner of the inner apartment, like a rag. The insect then appears almost in its winged state, except that there is a thin skin which wraps up the wings, and that appears to be nothing else but a liquor dried on their outside. Still, however, the little animal is too delicate and tender to venture from its retreat; but remains inclosed for some time longer; at length, when the members of this new insect have acquired the necessary consistence and vigour, it tears open its lodging, and breaks through its wall. For this purpose it has two teeth, like those of grasshoppers, with which it eats through, and enlarges the opening, till it gets out. Its body, which is turned like a screw, takes up no more than the space of a quarter of an inch; but when it is unfolded, it becomes half an inch in length; while its wings, that seemed to occupy the smallest space, in two minutes time unfold, and become longer than the body. In short, it becomes a large and beautiful fly, of the libellula kind, with a long, slender body, of a brown colour; a small head, with large, bright eyes, long, slender legs, and four large, transparent, recticulated wings. The rest of its habits resemble that insect whose form it bears; except, that instead of dropping its eggs in the water, it deposits them in sand, where they are soon hatched into that rapacious insect so justly admired for its method of catching its prey.

OF THE GRASSHOPPER, THE LOCUST, THE CICADA, THE CRICKET, AND THE MOLE CRICKET.

Belonging to the second order of insects we find a tribe of little animals, which, though differing in size and colour, strongly resemble each other in figure, appetites, nature, and transformation. But though they all appear of one family, yet men have been taught to hold them in different estimation: for while some of this tribe amuse him with their chirpings, and banish solitude from the fields, others come in swarms, eat up every thing that is green, and in a single night convert the most delightful landscape into a dreary waste. However, if these animals be separately considered, the devouring locust is not in the least more mischievous than the musical grasshopper; the only difference is, that one species make their approaches for food in a swarm, the other feed singly.

That animal which is called the grasshopper with us, differs greatly from the cicada of antiquity; for as our insect is active enough in hopping through the long grass, from whence it has taken its name, the cicada had not this power, but either walked or flew. The little hissing note also of our grasshopper is very different from the song of the cicada, which was louder and considerably more musical. The manner in which this note is produced by the two animals is very different: for the cicada makes it by a kind of buckler, which the male has beneath its belly; the grasshopper by a transparent membrane that covers a hole at the base of its wings. There is still a greater variety in all these with regard to shape and colour. Some are green, some black, some livid, and some variegated; but many of them do not show all their colours till they fly. Some have long legs, some short, some with more joints, others with fewer. Some sing, others are mute; some are innocent, doing no damage to the husbandman; while others do such prodigious mischief, that they are looked upon in some countries as one of the terrible scourges of the incensed Divinity.

Of this variegated tribe the little grasshopper that breeds in such plenty in every meadow, and that continues its chirping through the summer, is best known to us; and by having its history we shall be possessed of that of all the rest. This animal is of the colour of green leaves, except a line of brown which streaks the back, and two pale lines under the belly and behind the legs. It may be divided into the head, the corselet, and the belly. The head is oblong, regarding the earth, and bearing some resemblance to that of a horse. Its mouth is covered by a kind of round buckler jutting over it, and armed with teeth of a brown colour, hooked at the points. Within the mouth is perceivable a large, reddish tongue, and fixed to the lower jaw. The feelers or horns are very long, tapering off to a point; and the eyes are like two black specks, a little prominent. The corselet is elevated, narrow, armed above and below by two serrated spines. The back is armed with a strong buckler, to which the muscles of the legs are firmly bound, and round these muscles are seen the vessels by which the animal breathes, as white as snow. The last pair of legs are much longer and stronger than the first two pair, fortified by thick muscles, and very well formed for leaping. It has four wings; the anterior ones springing from the second pair of legs, the posterior from the third pair. The hinder wings are much finer and more expansive than the foremost, and are the principal instruments of its flight. The belly is considerably large, composed of eight rings, and terminated by a forky tail, covered with down, like the tail of a rat. When examined internally, besides the gullet we discover a small stomach; and behind that a very large one, wrinkled and furrowed on the inside: lower down there is still a third; so that it is not without reason that all the animals of this order are said to chew the cud, as they so much resemble ruminating animals in their internal conformation.

A short time after the grasshopper assumes its wings, it fills the meadow with its note; which, like that among birds, is a call to courtship. The male only of this trib is vocal; and, upon examining at the base of the wings, there will be found a little hole in its body, covered with a fine transparent membrane. This is supposed by Linnæus, to be the instrument it employs in singing: but others are of opinion the sound is produced by rubbing its hinder legs against each other: however this be, the note of one male is seldom heard, but it is returned by another; and the two little animals, after many mutual insults of this kind, are seen to meet and fight desperately. The female is generally the reward of victory; for, after the combat, the male seizes her with his teeth behind the neck, and thus keeps possession of her for several hours. Towards the latter end of autumn the female prepares to deposit her burden; and her body is then seen greatly distended with her eggs, which she carries to the number of one hundred and fifty. In order to make a proper lodgement in the earth for them, Nature has furnished her with an instrument at her tail, somewhat resembling a two-edged sword, which she can sheathe and unsheathe at pleasure: with this she pierces the earth as deep as she is able; and into the hole which her instrument has made, she deposits her eggs, one after another.

Having thus provided for the continuation of her posterity, the animal herself does not long survive; but as the winter approaches, she dries up, seems to feel the effects of age, and dies from a total decay. Some, however, assert, that she is killed by the cold; and others, that she is eaten by worms: but certain it is, that neither the male nor the female are ever seen to survive the winter. In the mean time the eggs which have been deposited, continue unaltered, either by the severity of the season or the retardation of the spring. They are of an oval figure, white, and of the consistence of horn: their size nearly equals that of a grain of anise: they are enveloped in the body within a covering, branched all over with veins and arteries; and when excluded, they crack, on being pressed between the fingers; their substance within is a whitish, viscous, and transparent fluid. In this manner they remain deposited beneath the surface of the earth, during the whole winter; till the genial return of spring begins to vivify and hatch them. The sun, by its warmth, beginning to animate all Nature, the insect eggs feel its benign influence: and, generally, about the beginning of May, every egg produces an insect, about the size of a flea. These, at first, are of a whitish colour; at the end of two or three days they turn black; and soon after they become of a reddish brown. They appear, from the beginning, like grasshoppers, wanting wings; and hop among the grass with great agility as soon as excluded.

Yet still they are by no means arrived at their state of full perfection; although they bear a strong resemblance to the animal in its perfect form. They want, or seem to want, the wings, which they at last appear to assume; and can only hop among the grass, without being able to fly. The wings, however, are not wanting, but are concealed within four little bunches, that seem to deform the sides of the animal: there they lie rolled up in a most curious manner; and occupying a smaller space than one would conceive who saw them extended. Indeed, all insects, notwithstanding the transmutations they seem to undergo, are yet brought forth with those very limbs, parts, and wings, which they afterwards seem to acquire. In the most helpless caterpillar, there is still to be observed the rudiments of that beautiful plumage which it afterwards expands when a butterfly: and though many new parts seem unfolded to the view, the animal acquires none but such as it was from the beginning possessed of. The grasshopper, therefore, though apparently without wings, is, in reality, from the first, possessed of those instruments, and only waits for sufficient force to break the bones that hold them folded up, and to give them their full expansion.

The grasshopper, that for above twenty days from its exclusion has continued without the use of its wings, which are folded up to his body, at length prepares for its emancipation, and for a life of greater liberty and pleasure. To make the proper dispositions for the approaching change, it ceases from its grassy food, and seeks about for a convenient place; beneath some thorn or thistle, that may protect it from an accidental shower. The same laborious writhings and workings, heavings and palpitations, which we have remarked in every other insect upon an approaching change, are exhibited in this. It swells up its head and neck; it then seems to draw them in again; and thus alternately, for some time, it exerts its powers to get free. At length, the skin covering the head and breast is perceived dividing above the neck; the head is seen issuing out first from the bursting skin; the efforts still continuing, the other parts follow successively; so that the little animal, with its long feelers, legs and all, works its way from the old skin, that remains fixed to the thistle or the thorn. It is, indeed, inconceivable how the insect can thus extricate itself from so exact a sheath as that which covered every part of its body.

The grasshopper, thus disengaged from its outer skin, appears in its perfect form; but then so feeble, and its body so soft and tender, that it may be moulded like wax. It is no longer of that obscure colour which it exhibited before, but a greenish white, which becomes more vivid as the moisture on the surface is dried away. Still, however, the animal continues to shew no signs of life, but appears quite spent and fatigued with its labour for more than hour together. During this time, the body is drying, and the wings unfolding to their greatest expansion, and the curious observer will perceive them, fold after fold, opening to the sun, till at last they become longer than the two hinder legs. The insect's body also is lengthened during this operation, and it becomes much more beautiful than before.

These insects are generally vocal in the midst of summer, and they are heard at sun-setting much louder than during the heats of the day. They are fed upon grass; and, if their belly be pressed, they will be observed to return the juices of the plants they have last fed upon. Though unwilling to fly, and slow in flight, particularly when the weather is moist or cool, they are sometimes seen to fly to considerable distances. If they are caught by one of the hinder legs, they quickly disengage themselves from it, and leave the leg behind them. This, however, does not grow again, as with crabs or spiders; for as they are animals but of a single year's continuance, they have not sufficient time for repairing those accidental misfortunes. The loss of their leg also prevents them from flying; for being unable to lift themselves in the air, they have not room upon the ground for the proper expansion of their wings. If they be handled roughly, they will bite very fiercely; and when they fly, they make a noise with their wings. They generally keep in the plain, where the grass is luxuriant, and the ground rich and fertile: there they deposit their eggs, particularly in those cracks which are formed by the heat of the sun.

Such are the habits and nature of those little vocal insects that swarm in our meadows, and enliven the landscape. The larger kinds only differ from them in size, in rapidity of flight, and the powers of injuring mankind, by swarming upon the productions of the earth. The quantity of grass which a few grasshoppers that sport in the fields can destroy is trifling; but when a swarm of locusts, two or three miles long, and several yards deep, settle upon a field, the consequences are dreadful. The annals of every country are marked with the devastation which such a multitude of insects produces; and though they seldom visit Europe in such dangerous swarms as formerly, yet, in some of the southern kingkoms, they are still formidable. Those which have at uncertain intervals visited Europe are supposed to have come from Africa, and the animal is called the great brown locust. It was seen in several parts of England in the year 1748, and many dreadful consequences were apprehended from its appearance. This insect is about three inches long; and has two horns or feelers, an inch in length. The head and horns are of a brownish colour; it is blue about the mouth, as also on the inside of the larger legs. The shield that covers the back is greenish; and the upper side of the body brown, spotted with black, and the under side purple. The upper wings are brown, with small dusky spots, one being larger at the tips; the under wings are more transparent, and of a light brown, tinctured with green, but there is a dark cloud of spots near the tips. This is that insect that has threatened us so often with its visitations; and that is so truly terrible in the countries where it is bred. There is no animal in the creation that multiplies so fast as these, if the sun be warm, and the soil in which their eggs are deposited be dry. Happily for us, the coldness of our climate, and the humidity of our soil, are no way favourable to their production; and as they are but the animals of a year, when they visit us they perish.

The Scripture, which was written in a country where the locust made a distinguished feature in the picture of nature, has given us several very striking pictures of this animal's numbers and rapacity. It compares an army, where the numbers are almost infinite, to a swarm of locusts: it describes them as rising out of the earth, where they are produced; as pursuing a settled march to destroy the fruits of the earth, and co-operating with Divine indignation.

When the locusts take the field, as we are assured, they have a leader at their head, whose flight they observe, and pay a strict attention to all his motions. They appear at a distance, like a black cloud, which, as it approaches, gathers upon the horizon, and almost hides the light of the day. It often happens that the husbandman sees this imminent calamity pass away without doing him any mischief; and the whole swarm proceed onward, to settle upon the labours of some less fortunate country. But wretched is the district upon which they alight; they ravage the meadow and the pasture ground; strip the trees of their leaves, and the garden of its beauty: the visitation of a few minutes destroys the expectation of twelve months; and a famine but too frequently ensues. In their native tropical climates they are not so dreadful as in the more southern parts of Europe. There, though the plain and the forest be stripped of their verdure, the power of vegetation is so great, that an interval of three or four days repairs the calamity: but our verdure is the livery of a season; and we must wait till the ensuing spring repairs the damage these locusts occasion. Besides, in their long flights to this part of the world, they are famished by the tediousness of their journey, and are therefore more voracious wherever they happen to settle. But it is not by what they devour that they do so much damage, as by what they destroy. Their very bite is thought to contaminate the plant, and to prevent its vegetation. To use the expression of the husbandman, they burn whatever they touch; and leave the marks of their devastation for two or three years ensuing. But if they be noxious while living, they are still more so when dead; for wherever they fall, they infect the air in such a manner, that the smell is insupportable. Orosius tells us, that in the year of the world 3800, there was an incredible number of locusts which infected Africa; and, after having eaten up every thing that was green, they flew off and were drowned in the African sea; where they caused such a stench, that the putrefying bodies of hundreds of thousands of men could not equal it.

In the year 1760 a cloud of locusts was seen to enter Russia in three different places; and from thence to spread themselves over Poland and Lithuania, in such astonishing multitudes, that the air was darkened, and the earth covered with their numbers. In some places they were seen lying dead, heaped upon each other four feet deep; in others they covered the surface like a black cloth; the trees bent beneath their weight; and the damage which the country sustained exceeded computation. In Barbary their numbers are formidable, and their visits are frequent. In the year 1724 Dr. Shaw was a witness in that country of the devastations they made. Their first appearance was about the latter end of March, when the wind had been southerly for some time. In the beginning of April their numbers were so vastly increased, that in the heat of the day they formed themselves into large swarms, which appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In the next month, being June, the young brood began to make their appearance, forming many compact bodies of several hundred yards square; and afterwards, marching forward, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, filling them with water. Some placed large quantities of heath, stubble, and such like combustible matter, in rows, and set them on fire on the approach of the locusts. But all this was to no purpose; for the trenches were quickly filled up, and the fires put out by the vast number of swarms that succeeded each other. A day or two after one of these was in motion, others that were just hatched came to glean after them, gnawing off the young branches and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state by casting their skins. To prepare themselves for this change they fixed their hinder feet to some bush or twig, or corner of a stone, when immediately, by an undulating motion used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes time; after which they were a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned again to their former greediness, with an addition both of strength and agility. But they did not continue long in this state before they were entirely dispersed; after laying their eggs, they directed their course northward, and probably perished in the sea. It is said that the holes these animals make to deposit their eggs in are four feet deep in the ground; the eggs are about fourscore in number, of the size of caraway comfits, and bundled up together in clusters.

It would be endless to recount all the mischiefs which these famished insects have at different times occasioned; but what can have induced them to take such distant flights, when they come into Europe, it is not so easy to be accounted for. The most probable conjecture is, that in consequence of a very dry season in the heart of Africa, they are propagated in such numbers that the vegetables of the spot where they are produced are not sufficient to sustain them. Thus being obliged to find out other countries, they traverse the sandy deserts, where they can find no sustenance; still meeting with nothing to allure them from their height, they proceed forward across the sea, and thus come into Europe, where they alight upon the first green pastures that occur.

In some parts of the world the inhabitants turn what seems a plague to their own advantage. Locusts are eaten by the natives in many kingdoms of the east; and are caught in small nets provided for that purpose. They parch them over the fire in an earthen pan; and when their wings and legs are fallen off, they turn reddish, of the colour of boiled shrimps. Dampier has eaten of them thus prepared, and thinks them a tolerable dish. The natives of Barbary also eat them fried with salt; and they are said to taste like cray-fish.

There is a locust in Tonquin, about the bigness of the top of a man's finger, and as long as the first joint. It breeds in the earth, in low grounds; and in the months of January and February, which is the season for taking them, they issue from the earth in vast swarms. At first they can hardly fly, so that they often fall into the rivers in great quantities; however, the natives in these months watch the rivers, and take them up in multitudes in small nets. They either eat them fresh, broiled on the coals, or pickle them for keeping. They are considered as a great delicacy in that part of the world, as well by the rich as the poor. In the countries where they are eaten, they are regularly taken to market, and sold as larks or quails in Europe. They must have been a common food with the Jews; for Moses, in the book of Leviticus, permits them to eat four different kinds of this animal, which he takes the precaution to specify. This dish, however, has not yet made its way into the kitchens of the luxurious in Europe; and though we may admire the delicacies of the East, we are as yet happily deprived of the powers of imitation.

Of all animals, however, of this noxious tribe, the great West Indian locust, individually considered, is the most formidable. It is about the thickness of the barrel of a goose-quill, and the body is divided into nine or ten joints, in the whole about six or seven inches long. It is furnished with two small eyes, standing out of the head like those of crabs, and two feelers like long hair. The whole body is studded with small excrescences, which are not much bigger than the points of pins. The shape is roundish, and the body diminishes in circumference towards the tail, which is forked into two horns. Between these, there is a sort of sheath containing a small dangerous sting. Should any person be unfortunate enough to touch this insect, he is sure to be stung; and is immediately taken with a shivering and a trembling all over the body; which, however, may soon be put a stop to, by rubbing the place that was affected with a little palm oil.

From the locust we descend to the cricket, which is a very inoffensive and pretty animal. Though there be a species of this insect that lives entirely in the woods and fields, yet that with which we are best acquainted is the house-cricket, whose voice is so well known behind a country fire in a winter's evening. There is something so unusual in hearing a sound while we do not see the animal producing it, nor discover the place from whence it comes, that among the country people the chirping of the cricket has been generally held ominous; and whether it deserts the fire-side, or pays an unexpected visit, the credulous peasantry always find something to be afraid of. In general, however, the killing of a cricket is considered as a most unlucky omen; and though their company is not much desired, yet no methods must be taken to remove them.

The cricket very much resembles the grasshopper in its shape, manner of ruminating, voice, leaping, and methods of propagation. It differs in its colour, which is uniformly of a rusty brown; in its food, which is more various; and in its place of residence, which is most usually in the warmest chinks behind a country hearth. They are, in some measure, obliged to the bad masonry employed in making peasants' houses for their retreats. The smallest chink serves to give them shelter; and where they once make their abode, they are sure to propagate. They are of a most chilly nature, seldom leaving the fire-side; and, if undisturbed, are seen to hop from their retreats to chirp at the blaze in the chimney. The wood-cricket is the most timorous animal in nature; but the chimney-cricket, being used to noises, disregards not only those, but even the appearance of people near it. Whether the voice of this animal be formed in the same manner with that of the grasshopper, by a fine membrane at the base of the wings, which is moved by a muscle, and which being coiled up, gives a sound like a quail pipe, has not been yet ascertained; nor do we well know the use of this voice, since anatomical inspection has not yet been able to discover the smallest organs of hearing. Still, however, we can make no doubt of their power of distinguishing sounds, though probably not in the same manner with the more perfect ranks of Nature. Certain it is, that I have often heard them call, and this call was as regularly answered by another, although none but the males are vocal.

As the cricket lives chiefly in the dark, so its eyes seem formed for the gloominess of its abode; and those who would surprise it, have only to light a candle unexpectedly; by which it is dazzled, and cannot find the way back to its retreat. It is a very voracious little animal, and will eat bread, flour, and meat; but it is particularly fond of sugar. They never drink, but keep for months together at the back of the chimney, where they could possibly have had no moisture. The warmth of their situation only serves to increase their mirth and loquacity. Except in the very coldest weather they never cease their chirping, but continue that little piercing note, which is as pleasing to some as it is disagreeable to others. The great Scaliger was particularly delighted with the chirping of crickets, and kept several of them for his amusement, inclosed in a box, which he placed in a warm situation. Others, on the contrary, think there is something ominous and melancholy in the sound, and use every endeavour to banish this insect from their houses. Ledelius tells us of a woman who was very much incommoded by crickets, and tried, but in vain, every method she could devise to banish them from her house. She at last accidentally succeeded; for having one day invited several guests to her house, where there was a wedding, in order to increase the festivity of the entertainment, she procured drums and trumpets to entertain them. The noise of those was so much greater than what the little animals were used to, that they instantly forsook their situation, and were never heard in that mansion again.

But of all the cricket kind, that which is called the *Mole-Cricket* is the most extraordinary. This animal is the largest of all the insects with which we are acquainted in this country, being two inches and a half in length, and three quarters of an inch in breadth. The colour is of a dusky brown; and at the extremity of the tail there are two hairy excrescences, resembling in some measure the tail of a mouse. The body consists of eight scaly joints or separate folds, is brown on the upper part, and more deeply tinged below. The wings are long, narrow, and terminate in a sharp point, each having a blackish line running down it: but when they are extended, they appear to be much broader than could at first sight be supposed. The shield of the breast is of a firm texture, of a blackish colour and hairy. The fore-feet, which are this animal's principal instruments of burrowing into the earth, are strong, webbed, and hairy; it generally, however, runs backward; but it is commonly under ground, where it burrows even faster than a mole. It is thought also to be amphibious; and capable of living under water, as well as under ground.

Of all insects this is the most detested by gardeners, as it chiefly resides in that ground which lies light, and where it finds sufficient plenty under the surface. Thus, in a single night's time, it will run along a furrow which has been newly sown, and rob it of all its contents. Its legs are formed in such a manner that it can penetrate the earth in every direction; before, behind, and above it. At night it ventures from its underground habitation, and, like the cricket, has its chirping call. When the female is fecundated, she makes a cell of clammy earth, the inside of which is large enough to hold two hazelnuts; and in this she lays her eggs.—The whole nest is about the size of a common hen's egg, closed up on every side, and well defended from the smallest breath of air. The eggs generally amount to the number of a hundred and fifty, being white, and about the size of a caraway comfit. They are thus carefully covered, as well to defend them from the injuries of the weather, as from the attacks of the black-beetle; that being itself an under-ground inhabitant, would, but for this precaution, devour or destroy them. To prevent this, the female mole-cricket is often posted as a centinel near the nest, and when the black invader plunges in to seize its prey, the guardian insect seizes him behind, and instantly bites him in two.

Nothing can exceed the care and assiduity which these animals exhibit in the preservation of their young. Wherever the nest is placed, there seems to be a fortification, avenues, and entrenchments, drawn round it in a very regular manner: there are numberless winding-ways that lead to it, and a ditch drawn about it, which few of its insect enemies are able to pass. But their care is not confined to this only; for at the approach of winter they carry their nest entirely away, and sink it deeper in the ground, so that the frost can have no influence in retarding the young brood from coming to maturity. As the weather grows milder, they raise their magazine in proportion; till, at last, they bring it as near the surface as they can, to receive the genial influence of the sun, without wholly exposing it to view; yet should the frost unexpectedly return, they sink it again as before.

OF THE EARWIG, THE FROTH INSECT, AND OTHERS BELONGING TO THE SECOND ORDER OF INSECTS.

We should still keep in memory that all insects of the second order, though not produced quite perfect from the egg, yet want very little of their perfection, and require but a very small change to arrive at that state which fits them for flight and some other purposes. The natural functions in these are never suspended; for, from the instant they leave the egg, they continue to eat, to move, to leap, and to pursue their prey: a slight change ensues: a skin that inclosed a part of their body and limbs, bursts behind, like a woman's stays, and gives freedom to a set of wings, with which the animal expatiates, and flies in pursuit of its mate.

Of all this class of insects, the earwig undergoes the smallest change. This animal is so common, that it scarcely needs a description: its swiftness in the reptile state is not less remarkable than its indefatigable velocity when upon the wing. That it must be very prolific, appears from its numbers; and that it is very harmless, every one's experience can readily testify. It is provided with six feet, and two feelers; the tail is forked; and with this it often attempts to defend itself against every assailant. But its attempts are only the threats of impotence; they draw down the resentment of powerful animals, but no way serve to defend it. The deformity of its figure, and its slender make, have also subjected it to an imputation, which, though entirely founded in prejudice, has more than once procured its destruction. It is supposed, as the name imports, that it often enters into the ears of people sleeping; thus causing madness, from the intolerable pain, and soon after death itself. Indeed, the French name, which signifies the ear-piercer, urges the calumny against this harmless insect in very plain terms: yet nothing can be more unjust: the ear is already filled with a substance which prevents any insect from entering; and besides, it is well lined and defended with membranes, which would keep out any little animal, even though the ear-wax were away. These reproaches, therefore, are entirely groundless: but it were well if the accusations which gardeners bring against the ear-wig were as slightly founded. There is nothing more certain than that it lives among flowers, and destroys them. Indeed, when fruit also has been wounded by flies, the earwig generally comes in for a second feast, and sucks those juices which they first began to broach. Still, however, this insect is not so noxious as it would seem; and seldom is found but where the mischief has been originally begun by others. Like all of this class, the earwig is hatched from an egg. As there are various kinds of this animal, so they choose different places to breed in: in general, however, they lay their eggs under the bark of plants, or in the clefts of trees, when beginning to decay. They proceed from the egg in that reptile state in which they are most commonly seen; and, as they grow larger, the wings bound under the skin begin to bourgeon. It is amazing how very little room four large wings take up before they are protruded; for no person could ever conceive such an expansion of natural drapery could be rolled up in so small a packet. The sheath in which they are enveloped, folds and covers them so neatly, that the animal seems quite destitute of wings; and even when they are burst from their confinement, the animal, by the power of the muscles and joints which it has in the middle of its wings, can closely fold them into a very narrow compass. When the earwig has become a winged insect, it flies in pursuit of the female, ceasing to feed, and is wholly employed in the business of propagation. It lives in its winged state but a few days; and having taken care for the continuance of posterity, dries up, and dies to all appearance consumptive.

To this order of insects we may also refer the cuckow spit, or froth worm, which is often found hid in that frothy matter that we find on the surface of plants. It has an oblong, obtuse body; and a large head, with small eyes. The external wings, for it has four, are of a dusky brown, marked with two white spots; the head is black. The spume in which it is found wallowing, is all of its own formation, and very much resembles frothy spittle. It proceeds from the vent of the animal, and other parts of the body; and if it be wiped away, a new quantity will be quickly seen ejected from the little animal's body. Within this spume it is observed in time to acquire four tubercles on its back, wherein the wings are enclosed: these bursting, from a reptile, it becomes a winged animal; and thus rendered perfect, it flies to meet its mate, and propagate its kind.

The water tipula also belongs to this class. It has an oblong slender body, with four feet fixed upon the breast, and four feelers near the mouth. It has four weak wings, which do not at all seem proper for flying, but leaping only. But what this insect chiefly demands our attention for is, the wonderful lightness wherewith it runs on the surface of the water, so as scarcely to put it in motion. It is sometimes seen in rivers, and on their banks, especially under shady trees; and generally in swarms of several together.

The common water-fly also breeds in the same manner with those above-mentioned. This animal is by some called notonecta, because it does not swim in the usual manner upon its belly, but on its back: nor can we help admiring that fitness in this insect for its situation, as it feeds on the under-side of plants which grow on the surface of the water; and therefore it is thus formed with its mouth upwards to take its food with greater convenience and ease.

We may also add the water-scorpion, which is a large insect, being near an inch in length, and about half an inch in breadth. Its body is nearly oval, but very flat and thin; and its tail long and pointed. The head is small; and the feelers appear like legs, resembling the claws of a scorpion, but without sharp points. This insect is generally found in ponds; and is supposed to be the most tyrannical and rapacious of the whole tribe of insects. It destroys, like a wolf among sheep, twenty times as many as its hunger requires. One of these, when put into a basin of water, in which were thirty or forty worms of the libellula kind, each as large as itself, destroyed them all in a few minutes; getting on their backs, and piercing with its trunk through their body. These animals, however, though so formidable to others, are nevertheless themselves greatly over-run with a little kind of louse, about the size of a nit, which very probably repays the injury which the water scorpion inflicts upon others.

The water-scorpions live in the water by day; out of which they rise in the dusk of the evening into the air, and so flying from place to place, frequently betake themselves in quest of food to other waters. The insect, before its wings are grown, remains in the place where it was produced; but when come to its state of perfection, sallies forth in search of a companion of the other sex, in order to continue its noxious posterity.

OF THE EPHEMERA.

The last insect we shall add to the second order is the ephemera; which, though it cannot be said strictly to belong to it, yet seems more properly referred to this rank than any other. Indeed we must not attend to the rigour of method, in a history where nature seems to take delight to sport in variety.

That there should be a tribe of flies whose duration extends but to a day seems at first surprising; but the wonder will increase, when we are told, that some of this kind seem to be born to die in the space of a single hour. The reptile, however, from which they are bred, is by no means so short lived; but is sometimes observed to live two years, and many times even for three years together.

All ephemeras, of which there are various kinds, are produced from the egg, in the form of worms; from whence they change into a more perfect form; namely, that of aurelias, which is a kind of middle state between a worm and a fly: and from thence they take their last mutation, which is into a beautiful fly, of longer or shorter duration, according to its kind.

The ephemera, in its fly state, is a very beautiful winged insect, and has a strong similitude to the butterfly, both from its shape and its wings. It is about the size of a middling butterfly; but its wings differ in not being covered with the painted dust with which those of butterflies are adorned, and rendered opaque; for they are very transparent and exceedingly thin. These insects have four wings, the uppermost of which are much the largest: when the insect is at rest, it generally lays its wings one over the other, on the back. The body is long, being formed of six rings, that are larger at the origin than near the extremity; and from this a tail proceeds, that is longer than all the rest of the fly, and consists sometimes of three threads of an equal length, or sometimes of two long and one short. To acquire this beautiful form the insect has been obliged to undergo several transmutations; but its glory is of very short duration, for the hour of its perfection is the hour of its death;

and it seems scarcely introduced to pleasure, when it is obliged to part with its life.

The reptile that is to become a fly, and that is granted so long a term, when compared to its latter duration, is an inhabitant of the water, and bears a very strong resemblance to fishes, in many particulars : having gills by which it breathes at the bottom, and also the tapering form of aquatic animals. These insects have six scaly legs, fixed on their corselet. Their head is triangular : the eyes are placed forward, and may be distinguished by their largeness and colour. The mouth is furnished with teeth ; and the body consists of six rings ; that next the corselet being largest, but growing less and less to the end : the last ring is the shortest, from which the three threads proceed, which are as long as the whole body. Thus we see that the reptile bears a very striking resemblance to the fly ; and only requires wings, to be very near its perfection.

As there are several kinds of this animal, their aurelias are consequently of different colours ; some yellow, some brown, and some cream-coloured. Some of these also bore themselves cells at the bottom of the water, from which they never stir out, but feed upon the mud composing the walls of their habitation, in contented captivity ; others, on the contrary, range about, go from the bottom to the surface, swim between two waters, quit that element entirely to feed upon plants by the river side, and then return to their favourite element, for safety and protection.

The reptile, however, though it continue to live two or three years, offers but little, in its long duration, to excite curiosity : it is hid at the bottom of the water, and feeds almost wholly within its narrow habitation. The most remarkable fact commands our attention during the short interval of its fly state ; into which it crowds the most various transactions of its little life. It then may be said to be in a hurry to live, as it has but so small a time to exist. The peculiar sign whereby to know that these reptiles will change into flies in a short time, consists in a protuberance of the wings on the back. About that time the smooth and depressed form of the upper part of the body is changed into a more swollen and rounder shape ; so that the wings are in some degree visible through the external sheath that covers them. As they are not natives of England, he who would see them in their greatest abundance, must walk, about sun-set, along the banks of the Rhine, or the Seine, near Paris ; where, for about three days, in the midst of summer, he will be astonished at their numbers and assiduity. The thickest descent of the flakes of snow in winter seem not to equal their number ; the whole air seems alive with the new-born race ; and the earth itself is all over covered with their remains. The aurelias, or reptile insects, that are as yet beneath the surface of the water, wait only for the approach of evening to begin their transformation. The most industrious shake off their old garments about eight o'clock ; and those who are the most tardy, are transformed before nine.

We have already seen that the operation of change in other insects is laborious and painful ; but with these nothing seems shorter, or performed with greater ease. The aurelias are scarcely lifted above the surface of the water, than their old sheathing skin bursts ; and through the cavity which is thus formed, a fly issues, whose wings, at the same instant, are unfolded, and at the same time lift it into the air. Millions and millions of aurelias, rise in this manner to the surface ; and at once become flies, and fill every quarter with their flutterings. But all these sports are shortly to have an end ; for as the little strangers live but an hour or two, the whole swarm soon falls to the ground, and covers the earth, like a deep snow, for several hundred yards, on every side of the river. Their numbers are then incredible, and every object they touch becomes fatal to them ; for they instantly die, if by chance they hit against even each other.

At this time the males and females are very differently employed. The males, quite inactive and apparently without desires, seem only born to die : no way like the males of other insects ; they neither follow the opposite sex, nor bear any enmity to each other : after fluttering for an hour or two, they drop upon land, without seeming to receive wings for scarcely any other purpose but to satisfy an idle curiosity ; but it is otherwise with the females ; for they are scarcely risen from the surface of the water, and have dried their wings, but they hasten to drop their eggs back again. If they happen also to flutter upon land, they deposit their burden in the place where they drop. But then it may be demanded, where, and in what manner, are these eggs fecundated, as no intercourse appears between the sexes, in their transitory visits in air ? Swammerdam is of opinion that they are impregnated in the manner of fish-spawn, by the male, after being ejected by the female : but, beside that this doctrine is exploded even from the history of fishes, it is certain that the males have not time for this operation, as the eggs drop to the bottom the instant they are laid on the water. The females are in such haste to deposit their eggs, that multitudes of them fall to the ground ; but the greatest part are laid in the water. As they flutter upon the surface, two clusters are seen issuing from the extremity of their bodies, each containing about three hundred and fifty eggs, which make seven hundred in all. Thus, of all insects, this appears to be the most prolific ; and it would seem that there was a necessity for such a supply, as, in its reptile state, it is the favourite food of every kind of fresh water fish. It is in vain that these little animals form galleries at the bottom of the river, from whence they seldom remove ; many kinds of fish break in upon their retreats, and thin their numbers.

For this reason fishermen are careful to provide themselves with these insects, as the most grateful bait; and thus turn the fish's rapacity to its own destruction.

But though the usual date of those flies is two or three hours at farthest, there are some kinds that live several days; and one kind in particular, after quitting the water, has another case or skin to get rid of. These are often seen in the fields and woods, distant from the water; but they are more frequently found in its vicinity. They are often observed sticking upon walls and trees; and frequently with the head downwards, without changing place, or having any sensible motion. They are then waiting for the moment when they shall be divested of their last incommodious garment, which sometimes does not happen for two or three days together.

INSECTS OF THE THIRD ORDER.

OF THE CATERPILLARS IN GENERAL.

If we take a cursory view of insects in general, caterpillars alone, and the butterflies and moths they give birth to, will make a third part of the number. Wherever we move, wherever we turn, these insects, in one shape or other, present themselves to our view. Some in every state, offer the most entertaining spectacle; others are beautiful only in their winged form. Many persons, (of which number Dr. Goldsmith acknowledged that he was one,) have an invincible aversion to caterpillars and worms of every species: there is something disagreeable in their slow, crawling motion, for which the variety of their colouring can never compensate. But others feel no repugnance at observing, and even handling them with the most attentive application.

There is nothing in the butterfly state so beautiful or splendid as these insects. They serve, not less than the birds themselves, to banish solitudes from our walks, and to fill up our idle intervals with the most pleasing speculations. The butterfly makes one of the principal ornaments of oriental poetry; but in the countries of the East the insect is larger and more beautiful than with us in England.

The beauties of the fly may therefore very well excite our curiosity to examine the reptile. But we are still more strongly attached to this tribe from the usefulness of one of the number. The silk-worm is perhaps the most serviceable of all other animals; since, from its labours, and the manufacture attending it, nearly a third part of the world are clothed, adorned, and supported.

Caterpillars may be easily distinguished from worms or maggots, by the number of their feet; and by their producing butterflies or moths. When the sun calls up vegetation, and vivifies the various eggs of insects, the caterpillars are the first that are seen upon almost every vegetable and tree, eating its leaves, and preparing for a state of greater perfection. They have feet both before and behind; which not only enable them to move forward by a sort of steps made by their fore and hinder parts, but also to climb up vegetables, and to stretch themselves out from the boughs and stalks to reach their food at a distance. All insects of this class have from eight feet, at the least, to sixteen; and this may serve to distinguish them from the worm tribe, that never have so many. The animal into which they are converted is always a butterfly or a moth; and these are constantly distinguished from other flies by having their wings covered over with a painted dust, which gives them such various beauty. The wings of flies are transparent, as we see in the common flesh-fly; while those of beetles are hard, like horn: from such the wings of a butterfly may be easily distinguished; and words would obscure their differences.

From hence it appears that caterpillars, whether in the reptile state, or advanced to their last state of perfection into butterflies, may easily be distinguished from all other insects; being animals peculiarly formed, and also of a peculiar nature. The transmutations they undergo are likewise more numerous than those of any insect hitherto mentioned; and, in consequence, they have been placed in the third order of changes by Swammerdam, who has thrown such extraordinary lights upon this part of natural history. In the second order of changes, mentioned before, we saw the grasshopper and the earwig, when excluded from the egg, assume a form very like that which they were afterwards to preserve; and seemed arrived at a state of perfection in all respects, except in not having wings; which did not bud forth until they were come to maturity. But the insects of this third order, that we are now about to describe, go through a much greater variety of transformations; for when they are excluded from the egg, they assume the form of a small caterpillar, which feeds and grows larger every day, often changing its skin, but still preserving its form. When the animal has come to a certain magnitude in this state, it discontinues eating, makes itself a covering or husk, in which it remains wrapped up, seemingly without life or motion; and after having for some time continued in this state, it once more bursts its confinement, and comes forth a butterfly. Thus we see this animal put on no less than three different appearances, from the time it is first excluded from the egg. It appears a crawling caterpillar; then an insensible aurelia, as it is called, without life or motion; and, lastly, a beautiful butterfly, variously painted, according to its different kind. Having thus distinguished this class of insects from all others, we shall first take a survey of their history in general; and then enter more particularly into the manners and nature of a few of them, which most deserve our curiosity and attention.

OF THE TRANSFORMATION OF THE CATERPILLAR INTO ITS CORRESPONDING BUTTERFLY OR MOTH.

When winter has disrobed the trees of their leaves, nature then seems to have lost her insects. There are thousands of different kinds, with and without wings, which, though swarming at other seasons, then entirely disappear. Our fields are re-peopled when the leaves begin to bud, by the genial influence of spring; and caterpillars of various sorts are seen feeding upon the promise of the year, even before the leaves are completely unfolded. Those caterpillars, which we then see, may serve to give us a view of the general means which nature employs to preserve such a number of insects during that season, when they can no longer find subsistence. It is known, by united experience, that all these animals are hatched from the eggs of butterflies; and those who observe them more closely will find the fly very careful in depositing its eggs in those places where they are likely to be hatched with the greatest safety and success. During winter, therefore, the greatest number of caterpillars are in an egg state: and in this lifeless situation brave all the rigours and the humidity of the climate; and though often exposed to all its changes, they still preserve the latent principle of life, which is more fully exerted at the approach of spring. That same power that pushes forth the budding leaf, and the opening flower, impels the insect into animation; and nature at once seems to furnish the guest and the banquet. When the insect has found force to break its shell, it always finds its favourite aliment provided in abundance before it.

But all caterpillars are not sent off from the egg in the beginning of spring; for many of them have subsisted during the winter in their aurelia state; in which, as we have briefly observed above, the animal is seemingly deprived of life and motion.. In this state of insensibility, many of these insects continue during the rigours of winter; some inclosed in a kind of shell, which they have spun for themselves at the end of autumn; some concealed under the bark of trees; others in the chinks of old walls; and many buried under ground. From all these a variety of butterflies are seen to issue in the beginning of spring, and adorn the earliest part of the year with their painted flutterings.

Some caterpillars, however, do not make any sort of change at the approach of winter; but continue to live in their reptile state through all the severity of the season. These choose for themselves some retreat, where they may remain undisturbed for months together; and there they continue motionless, and as insensible as if they were actually dead. Their constitution is such, that food at that time would be useless; and the cold hinders their making those dissipations which require restoration. In general caterpillars of this kind are found in great numbers together, inclosed in one common web, that covers them all, and serves to protect them from the injuries of the air.

Lastly, there are some of the caterpillar kind, whose butterflies live all the winter; and who, having fluttered about for some part of the latter end of autumn, seek for some retreat during the winter, in order to answer the ends of propagation, at the approach of spring. These are often found motionless in the hollows of trees, or the clefts of timber; but by being carried near to the fire, they recover life and activity, and seem to anticipate the desires of spring.

In general, however, whether the animal has subsisted in an egg state, during the winter; or whether as a butterfly, bred from an aurelia, in the beginning of spring; or a butterfly that has subsisted during the winter, and lays eggs as soon as the leaves of plants are shot forward, the whole swarm of caterpillars are in motion to share the banquet that nature has provided. There is scarcely a plant that has not its own peculiar insects; and some are known to support several of different kinds. Of these many are hatched from the egg, at the foot of the tree, and climb up to its leaves for subsistence; the eggs of others have been glued by the parent butterfly to the leaves; and they are no sooner excluded from the shell, but they find themselves in the midst of plenty.

When the caterpillar first bursts from the egg, it is small and feeble; its appetites are in proportion to its size, and it seems to make no great consumption; but as it increases in magnitude, it improves in its appetites; so that, in its adult caterpillar state, it is the most ravenous of all animals whatever. A single caterpillar will eat double its own weight of leaves in a day, and yet seems no way disordered by the meal. What would mankind do, if their oxen or their horses were so voracious?

These voracious habits, with its slow crawling motion, but still more a stinging, like that of nettles, which follows upon handling the greatest number of them, make these insects not the most agreeable objects of human curiosity. But there are many philosophers who have spent years in their [illegible]plation ; and who have not only attended to their ha[illegible] labours, but minutely examined their structure and internal conformation.

The body of the caterpillar, when anatomically considered, is found composed of rings, whose circumference is pretty nearly circular or oval. They are generally twelve in number, and are all membranous ; by which caterpillars may be distinguished from many other insects that nearly resemble them in form. The head of the caterpillar is connected to the first ring by the neck ; which is generally so short and contracted, that it is scarcely visible. All the covering of the head in caterpillars seems to consist of a shell ; and they have neither upper nor under jaw, for they are both placed rather vertically, and each jaw armed with a large thick tooth, which is singly equal to numbers. With these the animals devour their food in such amazing quantities ; and with these, some of the kind defend themselves against their enemies. Though the mouth be kept shut, the teeth are always uncovered ; and while the insect continues in health, they are seldom without employment. Whatever the caterpillar devours, these teeth serve to chop it into small pieces, and render the parts of the leaf fit for swallowing. Many kinds, while they are yet young, eat only the succulent part of the leaf, and leave all the fibres untouched ; others, however, attack the whole leaf, and eat it clean away. One may be amused, for a little time, in observing the avidity with which they are observed to feed ; some are seen eating the whole day ; others have their hours of repast ; some choose the night, and others the day. When the caterpillar attacks a leaf, it places its body in such a manner that the edge of the leaf shall fall between its feet which keeps it steady while the teeth are employed in cutting it : these fall upon the leaf, somewhat in the manner of a pair of gardener's shears : and every morsel is swallowed as soon as cut. Some caterpillars feed upon leaves so very narrow, that they are not broader than their mouths ; in this case the animal is seen to devour it from the point, as we would eat a radish.

As there are various kinds of caterpillars, the number of their feet are various ; some having eight, and others sixteen. Of these feet the six foremost are covered with a sort of shining gristle ; and are therefore called the shelly legs. The hindmost feet, whatever be their number, are soft and flexible, and are called membranous. Caterpillars also, with regard to their external figure, are either smooth or hairy. The skin of the first kind is soft to the touch, or hard like shagreen ; the skin of the latter is hairy, and, as it were, thorny ; and generally, if handled, stings like nettles. Some of them even cause this stinging pain, if but approached too nearly.

Caterpillars, in general, have six small black spots placed on the circumference of the fore ring, and a little to the side of the head. Three of these are larger than the rest, and are convex and transparent ; these Reaumur takes to be the eyes of the caterpillar ; however, most of these reptiles have very little occasion for sight, and seem only to be directed by their feeling.

But the parts of the caterpillar's body which most justly demand our attention, are the stigmata, as they are called ; or those holes on the sides of its body, through which the animal is supposed to breathe. All along this insect's body, on each side, these holes are easily discoverable. They are eighteen in number, nine on a side, rather nearer the belly than the back ; a hole for every ring, of which the animal's body is composed, except the second, the third, and the last. These oval openings may be considered as so many mouths, through which the insect breathes ; but with this difference, that as we have but one pair of lungs, the caterpillar has no less than eighteen. It requires no great anatomical dexterity to discover these lungs in the larger kind of caterpillars ; they appear, at first view, to be hollow cartilagious tubes, and of the colour of mother-of-pearl. These tubes are often seen to unite with each other ; some being perceived to open into the intestines ; and some go to different parts of the surface of the body. That these vessels serve to convey the air, appears evidently from the famous experiment of Malpighi, who, by stopping up the mouths of the stigmata with oil, quickly suffocated the animal, which was seen to die convulsed the instant after. In order to ascertain his theory, he rubbed oil upon other parts of the insect's body, leaving the stigmata free ; and this seemed to have no effect upon the animal's health, but it continued to move and eat as usual : he rubbed oil on the stigmata of one side, and the animal underwent a partial convulsion, but recovered in a short time. However it ought to be observed, that air is not so necessary to these as to the nobler ranks of animals, since caterpillars will live in an exhausted receiver for several days together : and though they seem dead at the bottom, yet, when taken out, recover, and resume their former vivacity.

If the caterpillar be cut open longitudinally along the back, its intestines will be perceived running directly in a straight line from the mouth to the anus. They resemble a number of small bags opening into each other ; and strengthened on both sides by a fleshy cord, by which they are united. These insects are, upon many occasions ; seen to cast forth the internal coat of their intestines with their food, in the changes which they so frequently undergo. But the intestines take up but a small part of the animal's body, if compared to the fatty substance in which they are involved. This substance changes its colour when the insect's metamorphosis begins to approach ; and from white it is usually seen to become yellow. If to these parts we add the caterpillar's implements for spinning, (for all caterpillars spin at one time or other,) we shall have a rude sketch of this animal's conformation; however, we shall reserve the description of those parts, till we have occasion to treat of the history of the silk-worm, where the manner in which these insects spin their webbs, will most properly find place.

The life of a caterpillar seems one continued succession of changes, and it is observed to throw off one skin only to assume another; which also is divested in its turn: and thus for eight or ten times successively. We must not, however, confound this changing of the skin with the great metamorphosis which it is afterwards to undergo. The throwing off one skin, and assuming another, seems, in comparison, but a slight operation among these animals: this is but the work of a day; the other is the great adventure of their lives. Indeed this faculty of changing the skin, is not peculiar to caterpillars only, but is common to all the insect kind and even to some animals that claim a higher rank in Nature. We have already spoken of the lobster and the crab outgrowing their first shells, and then bursting from their confinement, in order to assume a covering more roomy and convenient. It is probable that the louse, the flea, and the spider, change their covering from the same necessity; and growing too large for the crust in which they have been for some time enclosed, burst it for another. This period is probably that of their growth; for so soon as their new skin is hardened round them, the animal's growth is necessarily circumscribed, while it remains within it. With respect to caterpillars, many of them change their skins five or six times in a season; and this covering, when cast off, often seems so complete, that many might mistake the empty skin for the real insect. Among the hairy caterpillars, for instance, the cast skin is covered with hair; the feet, as well gristly as membranous, remain fixed to it; even the parts which nothing but a microscope can discover, are visible in it; in short, all the parts of the head; not only the skull but the teeth.

In proportion as the time approaches in which the caterpillar is to cast its old skin, its colours become more feeble, the skin seems to wither and become dry, and in some measure resembles a leaf, when it is no longer supplied with moisture from the stock. At that time the insect begins to find itself under a necessity of changing; and it is not effected without violent labour, and perhaps pain. A day or two before the critical hour approaches, the insect ceases to eat, loses its usual activity, and seems to rest immoveable. It seeks some place to remain in security; and no longer timorous, seems regardless even of the touch. It is now and then seen to bend itself and elevate its back; again it stretches to its utmost extent: it sometimes lifts up its head, and then lets it fall again; it sometimes waves it three or four times from side to side, and then remains in quiet. At length, some of the rings of its body, particularly the first and the second, are [illegible] to swell considerably, the old skin distends and bursts, till, by repeated swellings and contractions in every ring, the animal disengages itself, and creeps from its inconvenient covering.

How laborious soever this operation may be, it is performed in the space of a minute; and the animal, having thrown off its old skin, seems to enjoy new vigour, as well as acquired colouring and beauty. Sometimes it happens that it takes a new appearance and colours very different from the old. Those that are hairy, still preserve their covering; although their ancient skin seems not to have lost a single hair: every hair appears to have been drawn like a sword from the scabbard. But the fact is, that a new crop of hair grows between the old skin and the new, and probably helps to throw off the external covering.

The caterpillar having in this manner continued for several days feeding, and at intervals casting its skin, begins at last to prepare for its change into an aurelia. It is most probable that, from the beginning, all the parts of the butterfly lay hid in this insect, in its reptile state; but it required time to bring them to perfection; and a large quantity of food, to enable the animal to undergo all the changes requisite for throwing off these skins, which seem to clog the butterfly form. However, when the caterpillar has fed sufficiently, and the parts of the future butterfly have formed themselves beneath its skin, it is then time for it to make its first, great, and principal change into an aurelia, or a chrysalis, as some have chosen to call it; during which, as was observed, it seems to remain for several days, or even months, without life or motion.

Preparatory to this important change, the caterpillar most usually quits the plant, or the tree on which it fed; or at least attaches itself to the stalk or the stem, more gladly than the leaves. It forsakes its food, and prepares, by fasting, to undergo its transmutation. In this period, all the food it has taken is thoroughly digested; and it often voids even the internal membrane which lined its intestines. Some of this tribe, at this period also, are observed entirely to change colour; and the vivacity of the tints, in all, seems faded. Those of them which are capable of spinning themselves a web, set about this operation; those which have already spun, await the change in the best manner they are able. The web or cone, with which some cover themselves, hides the aurelia contained within from the view; but in others, where it is more transparent, the caterpillar, when it has done spinning, strikes into it the claws of the two feet under the tail, and afterwards forces in the tail itself, by contracting those claws, and violently striking the feet one against the other. If, however, they be taken from their web at this time, they appear in a state of great languor; and, incapable of walking, remain on that spot where they are placed. In this condition they remain one or two days, preparing to change into an aurelia; somewhat in the manner they made preparations for changing their skin. They then appear with their bodies bent into a bow, which they now and then are seen to straighten: they make no use of their legs; but if they attempt to change place, do it by the contortions of their body. In proportion as their change into an aurelia approaches, their body becomes more and more bent; while their extensions and convulsive contractions become more frequent. The hinder end of the body is the part which the animal first disengages from its caterpillar skin; that part of the skin remains empty, while the body is drawn up contractedly towards the head. In the same manner they disengage themselves from the two succeeding rings; so that the animal is then lodged entirely in the fore part of its caterpillar covering: that half which is abandoned, remains placid and empty; while the fore part, on the contrary, is swollen and distended. The animal, having thus quitted the hinder part of its skin, to drive itself up into the fore part, still continues to heave and work as before; so that the skull is soon observed to burst into three pieces, and a longitudinal opening is made in the three first rings of the body, through which the insect thrusts forth its naked body with strong efforts. Thus at last it entirely gets free from its caterpillar skin, and for ever forsakes its most odious reptile form.

The caterpillar, thus stripped of its skin for the last time, is now become an aurelia; in which the parts of the future butterfly are all visible; but in so soft a state that the smallest touch can discompose them. The animal is now become helpless and motionless; and only waits for the assistance of the air to dry up the moisture on its surface, and supply it with a crust capable of resisting external injuries. Immediately after being stripped of its caterpillar skin, it is of a green colour, especially in those parts which are distended by an extraordinary afflux of animal moisture; but in ten or twelve hours after being thus exposed, its parts harden, the air forms its external covering into a firm crust, and in about four and twenty hours the aurelia may be handled without endangering the little animal that is thus left in so defenceless a situation. Such is the history of the little pod or cone that is found so common by every pathway, sticking to nettles, and sometimes shining like polished gold. From the beautiful and resplendent colour, with which it is thus occasionally adorned, some authors have called it a chrysalis, implying a creature made of gold.

Such are the efforts by which these little animals prepare for a state of perfection; but their care is still greater to provide themselves a secure retreat during this season of their imbecility. It would seem like erecting themselves a monument, where they were to rest secure, until Nature had called them into a new and more improved existence. For this purpose some spin themselves a cone or web, in which they lie secure till they have arrived at maturity: others, that cannot spin so copious a covering, suspend themselves by the tail, in some retreat where they are not likely to meet disturbances. Some mix sand with their gummy and moist webs, and thus make themselves a secure incrustation; while others, before their change, bury themselves in the ground, and thus avoid the numerous dangers that might attend them. One would imagine that they were conscious of the precise time of their continuance in their aurelia state; since their little sepulchres, with respect to the solidity of the building, are proportioned to such duration. Those that are to lie in that state of existence but a few days, make choice of some tender leaf, which they render still more pliant by diffusing a kind of glue upon it: the leaf thus gradually curls up, and withering as it enfolds, the insect wraps itself within, as in a mantle, till the genial warmth of the sun enables it to struggle for new life, and burst from its confinement. Others, whose time of transformation is also near at hand, fasten their tails to a tree, or to the first worm-hole they meet in a beam, and wait in that defenceless situation. Such caterpillars, on the other hand, as are seen to lie several months in their aurelia state, act with much greater circumspection. Most of them mix their web with sand, and thus make themselves a strong covering: others build in wood, which serves them in the nature of a coffin. Such as have made the leaves of willows their favourite food, break the tender twigs of them first into small pieces, then pound them as it were to powder; and, by means of their glutinous silk, make a kind of paste, in which they wrap themselves up. Many are the forms which these animals assume in this helpless state; and it often happens that the most deformed butterflies issue from the most beautiful aurelias.

The aurelia, however, generally takes the rude outline of the parts of the animal which is contained within it; but as to the various colours which it is observed to assume, they are rather the effect of accident; for the same species of insect does not at all times assume the same hue, when it becomes an aurelia. In some the beautiful gold colour is at one time found; in others it is wanting. This brilliant hue, which does not fall short of the best gilding, is formed in the same manner in which we see leather obtain a gold colour, though none of that metal ever enters into the tincture. It is only formed by a beautiful brown varnish, laid upon a white ground; and the white thus gleaming through the transparency of the brown, gives a charming golden yellow. These two colours are found, one over the other, in the aurelia of the little animal we are describing; and the whole appears gilded, without any real gilding.

The aurelia thus formed, and left to time to expand into a butterfly, in some measure resembles an animal in an egg, that is to wait for external warmth to hatch it into life and vigour. As the quantity of moisture that is inclosed within the covering of the aurelia continues to keep its body in the most tender state, so it is likewise requisite that this humidity should be dried away before the little butterfly can burst its prison. Many have been the experiments to prove that nature may in this respect be assisted by art; and that the life of the insect may be retarded or quickened, without doing it the smallest injury. For this purpose it is only necessary to continue the insect in its aurelia state, by preventing the evaporation of its humidity; which will consequently add some days, nay weeks, to its life: on the other hand, by evaporating its moisture, in a warm situation, the animal assumes its winged state before its usual time, and goes through the offices assigned its existence. To prove this M. Reaumur enclosed the aurelia in a glass tube; and found the evaporated water, which exhaled from the body of the insect, collected in drops at the bottom of the tube: he covered the aurelia with varnish; and this making the evaporation more difficult and slow, the butterfly was two months longer than its natural term in coming out of its case; he found, on the other hand, that by laying the animal in a warm room, he hastened the disclosure of the butterfly; and by keeping it in an ice-house in the same manner he delayed it. Warmth acted, in this case, in a double capacity: invigorating the animal, and evaporating the moisture.

The aurelia, though it bears a different external appearance, nevertheless contains within it all the parts of the butterfly in perfect formation; and lying each in a very orderly manner, though in the smallest compass. These, however, are so fast and tender, that it is impossible to visit without discomposing them. When either by warmth, or increasing vigour, the parts have acquired the necessary force and solidity, the butterfly then seeks to disembarrass itself of those bands which kept it so long in confinement. Some insects continue under the form of an aurelia not above ten days; some twenty; some several months; and even during a whole year.

But the butterfly does not continue so long under the form of an aurelia, as one would be apt to imagine. In general those caterpillars that provide themselves with cones, continue within them but a few days after the cone is completely finished. Some, however, remain buried in this artificial covering for eight or nine months without taking the smallest sustenance during the whole time: and though in the caterpillar state no animals were so voracious, when thus transformed they appear a miracle of abstinence. In all, sooner or later, the butterfly bursts from its prison; not only that natural prison which is formed by the skin of the aurelia, but also from that artificial one of silk, or any other substance in which it has thought fit to enclose itself.

The efforts which the butterfly makes to get free from its aurelia state, are by no means so violent as those which the insect had in changing from the caterpillar into the aurelia. The quantity of moisture surrounding the butterfly is by no means so great as that attending its former change; and the shell of the aurelia is so dry, that it may be cracked between the fingers.

If the animal be shut up within a cone, the butterfly always gets rid of the natural internal skin of the aurelia, before it eats its way through the external covering which its own industry has formed round it. In order to observe the manner in which it thus gets rid of the aurelia covering, we must cut open the cone, and then we shall have an opportunity of discovering the insect's efforts to emancipate itself from its natural shell. When this operation begins, there appears to be a violent agitation in the humours contained within the little animal's body. Its fluid seems driven, by an hasty fermentation, through all the vessels; while it labours violently with its legs, and makes several other violent struggles to get free. As all these motions concur with the growth of the insect's wings and body, it is impossible that the brittle skin which covers it should longer resist: at length it gives way, by bursting into four distinct and regular pieces. The skin of the head and legs first separates: then the skin at the back flies open, and dividing into two regular portions, disengages the back and wings: then there likewise happens another rupture in that portion which covered the rings of the back of the aurelia. After this the butterfly, as if fatigued with its struggles, remains very quiet for some time, with its wings pointed downwards, and its legs fixed in the skin which it had just thrown off. At first sight the animal, just emancipated from its former shackles, and permitted the future use of its wings, seems to want them entirely; they take up such little room, that one would wonder where they were hidden. But soon after, they expand so rapidly, that the eye can scarcely attend their unfolding. From reaching hardly half the length of the body, they acquire in a most wonderful manner their full extent and bigness, so as to be each five times larger than they were before. Nor is it the wings alone that are thus increased: all their spots and paintings, before so minute as to be scarcely discernible, are proportionably extended; so that what a few minutes before seemed only a number of confused, unmeaning points, now become distinct and most beautiful ornaments. Nor are the wings, when they are thus expanded, unfolded in the manner in which earwigs and grasshoppers display theirs, who unfurl them like a lady's fan; on the contrary, those of butterflies actually grow to their natural size in this very short space. The wing, at the instant it is freed from its late confinement, is considerably thicker than afterwards; so that it spreads in all its dimensions, growing thinner as it becomes broader. If one of the wings be plucked from the animal just set free, it may be spread by the fingers, and it will soon become as broad as the other, which has been left behind. As the wings extend themselves so suddenly, they have not yet had time to dry; and accordingly appear like pieces of wet paper, soft and full of wrinkles. In about half an hour, they are perfectly dry, their wrinkles entirely disappear, and the little animal assumes all its splendour. The transmutation being thus completely finished, the butterfly discharges three or four drops of a blood-coloured liquid, which are the last remains of its superfluous moisture. Those aurelias which are enclosed within a cone, find their exit more difficult, as they have still another prison to break through: this, however, they perform in a short time; for the butterfly, freed from its aurelia skin, butts with its head violently against the walls of its artificial prison; and probably with its eyes, that are rough and like a file, it rubs the internal surface away; till it is at last seen forcing its way into open life; and, in less than a quarter of an hour, the animal acquires its full perfection.

Thus, to use the words of Swammerdam, we see a little insignificant creature distinguished, in its last birth, with qualifications and ornaments, which man, during his stay upon earth, can never even hope to acquire. The butterfly, to enjoy life, needs no other food but the dews of Heaven, and the honeyed juices which are distilled from every flower. The pageantry of princes cannot equal the ornaments with which it is invested; nor the rich colouring that embellishes its wing. The skies are the butterfly's proper habitation, and the air its element: whilst man comes into the world naked, and often roves about without habitation or shelter; exposed, on the one hand, to the heat of the sun; and, on the other, to the damps and exhalations of the earth; both alike enemies of his happiness and existence. A strong proof that, while this little animal is raised to its greatest height, we are as yet in this world, only candidates for perfection!

OF BUTTERFLIES AND MOTHS.

It has been already pointed out that all butterflies are bred from caterpillars; and we have exhibited the various circumstances of that surprising change. It has been remarked, that butterflies may be easily distinguished from flies of every other kind, by their wings; for, in others, they are either transparent, like gauze, as we see in the common flesh fly; or they are hard and crusted, as we see in the wings of the beetle. But in the butterfly, the wings are soft, opaque, and painted over with a beautiful dust that comes off with handling.

The number of these beautiful animals is very great; and though Linnæus has reckoned up above seven hundred and sixty different kinds, the catalogue is still very incomplete. Every collector of butterflies can exhibit undescribed species: and such as are fond of minute discovery, can here produce animals that have been examined only by himself. In general, however, those of the warm climates, are larger and more beautiful than such as are bred in England; and we can easily admit the beauty of the butterfly, since we are thus freed from the damage of the caterpillar. It has been the amusement of some to collect these animals, from different parts of the world; or to breed them from caterpillars at home. These they arrange in systematic order, or dispose so as to make striking and agreeable pictures; and all must grant, that this specious idleness is far preferable to that unhappy state which is produced by a total want of employment.

The wings of butterflies, as was observed, fully distinguish them from flies of every other kind. They are four in number; and although two of them be cut off, the animal can fly with the two others remaining. They are in their own substance, transparent; but owe their opacity to the beautiful dust with which they are covered; and which has been likened by some naturalists, to the feathers of birds; by others to the scales of fishes; as their imaginations were disposed to catch the resemblance. In fact, if we regard the wing of a butterfly with a good microscope, we shall perceive it studded over with a variety of little grains of different dimensions and forms, generally supported upon a footstalk, regularly laid upon the whole surface. Indeed, nothing can exceed the beautiful and regular arrangement of these little substances, which thus serve to paint the butterfly's wing, like the tiles of a house. Those of one rank are a little covered by those that follow: they are of many figures; on one part of the wing may be seen a succession of oval studs; on another part, a cluster of studs, each in the form of a heart; in one place they resemble a hand open: and in another they are long and triangular: while all are interspersed with taller studs, that grow between the rest, like mushrooms upon a stalk. The wing itself is composed of several thick nerves, which render the construction exceedingly strong, though light; and though it be covered over with thousands of these scales or studs, yet its weight is very little increased by the number. The animal is with ease enabled to support itself a long while in the air, although its flight be not very graceful. When it designs to fly to a considerable distance, it ascends and descends alternately; going sometimes to the right, sometimes to the left, without any apparent reason. Upon closer examination, however, it will be found that it flies thus irregularly in pursuit of its mate; and as dogs bait and quarter the ground in pursuit of their game, so these insects traverse the air in quest of their mates whom they can discover at more than a mile's distance.

If we prosecute our description of the butterfly, the animal may be divided into three parts; the head, the corselet, and the body.

The body is the hinder part of the butterfly, and is composed of rings, which are generally concealed under long hair, with which that part of the animal is clothed. The corselet is more solid than the rest of the body, because the fore-wings and the legs are fixed therein. The legs are six in number, although four only are made use of by the animal; the two fore-legs being often so much concealed in the long hair of the body, that it is sometimes difficult to discover them. If we examine these parts internally, we shall find the same set of vessels in the butterfly that we observed in the caterpillar, but with this great difference, that as the blood or humours in the caterpillar, circulated from the tail to the head, they are found in the butterfly to take a direct contrary course, and to circulate from the head to the tail; so that the caterpillar may be considered as the embryo animal, in which, as we have before seen, the circulation is carried on differently from what it is in animals when excluded.

But leaving the other parts of the butterfly, let us turn our attention particularly to the head. The eyes of butterflies have not all the same form; for in some they are large, in others small; in some, they are the larger portion of a sphere, in others they are but a small part of it, and just appearing from the head. In all of them, however, the outward coat has a lustre, in which may be discovered the various colours of the rainbow. If examined a little closely, it will be found to have the appearance of a multiplying glass; having a great number of sides or facets, in the manner of a brilliant cut diamond. In this particular, the eye of the butterfly, and of most other insects, entirely correspond; and Lewenhoek pretends, there are above six thousand facets on the cornea of a flea. These animals, therefore, see not only with great clearness, but view every object multiplied in a surprising manner. Puget adapted the cornea of a flea in such a position, as to see objects through it by the means of a microscope; and nothing could exceed the strangeness of its representations. A soldier, who was seen through it, appeared like an army of pigmies; for, while it multiplied, it also diminished the object; the arch of a bridge exhibited a spectacle more magnificent than human skill could perform; the flame of a candle seemed a beautiful illumination. But it still remains a doubt, whether the insect sees objects singly, as with one eye, or whether every facet is itself a complete eye, exhibiting its own object distinct from all the rest.

Butterflies, as well as most other flying insects, have two instruments, like horns, on their heads, which are commonly called feelers. They differ from the horns of greater animals, in being moveable at their base; and in having a great number of joints, by which means the insect is enabled to turn them in every direction. Those of butterflies are placed at the top of the head, pretty near to the external edge of each eye. What the use of these instruments may be, which are thus formed with so much art, and by a WORKMAN who does nothing without reason, is as yet unknown to man. They may serve to guard the eye; they may be of use to clean it; or they may be the organ of some sense which we are ignorant of: but this is only explaining one difficulty by another. We are not so ignorant of the uses of the trunk, which few insects of the butterfly kind are without. This instrument is placed exactly between the eyes; and when the animal is not employed in seeking its nourishment, it is rolled up like a curl. A butterfly, when it is feeding, flies round some flower, and settles upon it. The trunk is then uncurled, and thrust out either wholly or in part; and is employed in searching the flower to its very bottom, let it be ever so deep.

This search being repeated seven or eight times, the butterfly then passes to another; and continues to hover over those agreeable to its taste, like a bird over its prey. This trunk consists of two equal hollow tubes, nicely joined to each other, like the pipes of an organ.

Such is the figure and conformation of these beautiful insects that cheer our walks, and give us the earliest intimations of summer. But it is not by day alone that they are seen fluttering wantonly from flower to flower, as the greatest number of them fly by night, and expand the most beautiful colouring at those hours when there is no spectator. This tribe of insects has, therefore, been divided into Diurnal and Nocturnal Flies; or, more properly speaking, into Butterflies and Moths: the one flying only by day, the other most usually on the wing in the night. They may be easily distinguished from each other, by their horns or feelers: those of the butterfly being clubbed, or knobbed at the end; those of the moth tapering finer and finer to a point. To express it technically—the feelers of butterflies are clavated; those of moths are filiform.

The butterflies, as well as the moths, employ the short life assigned them, in a variety of enjoyments. Their whole time is spent either in quest of food, which every flower offers; or in pursuit of the female whose approach they can often perceive at two miles distance. Their sagacity in this particular is not less astonishing than true; but by what sense they are thus capable of distinguishing each other at such distances, is not easy to conceive. It cannot be by the sight, since such small objects as they are must be utterly imperceptible at half the distance at which they perceive each other: it can scarcely be by the sense of smelling, since the animal has no organs for that purpose. Whatever be their powers of perception, certain it is, that the male, after having fluttered, as if carelessly, about for some time, is seen to take wing, and go forward, sometimes for two miles together, in a direct line, to where the female is perched on a flower.

The general rule among insects is, that the female is larger than the male; and this obtains particularly in the tribe I am describing. The body of the male is smaller and more slender; that of the female more thick and oval. Previous to the junction of these animals, they are seen sporting in the air, pursuing and flying from each other, and preparing by a mock combat for the more important business of their lives.

But the females of many moths and butterflies seem to have assumed their airy form for no other reason but to fecundate their eggs and lay them. They are not seen fluttering about in quest of food or a mate; but having been in company with the male about half an hour, they deposit their eggs, and die, without taking any nourishment or seeking any.

The eggs of female butterflies are disposed in the body like a bed of chaplets; which, when excluded, are usually oval, and of a whitish colour: some, however, are quite round; and others flatted, like a turnip. The covering, or shell of the egg, though solid, is thin and transparent; and in proportion as the caterpillar grows within the egg, the colours change, and are distributed differently. The butterfly seems very well instructed by nature in its choice of the plant, or the leaf, where it shall deposit its burthen. Each egg contains but one caterpillar; and it is requisite that this little animal, when excluded, should be near its peculiar provision. The butterfly, therefore, is careful to place her brood only upon those plants that afford good nourishment to its posterity. Though the little winged animal has been fed itself upon dew, or the honey of flowers, yet it makes choice for its young of a very different provision, and lays its eggs on the most unsavoury plants; the rag-weed, the cabbage, or the nettle. Thus every butterfly chooses not the plant most grateful to it in its winged state; but such as it has fed upon in its reptile form.

All the eggs of butterflies are attached to the leaves of the favourite plant, by a sort of size or glue; where they continue unobserved, unless carefully sought after. The eggs are sometimes placed round the tender shoots of plants, in the form of bracelets, consisting of above two hundred in each, and generally surrounding the shoot, like a ring upon a finger. Some butterflies secure their eggs from the injuries of air, by covering them with hair, plucked from their own bodies, as birds sometimes are seen to make their nests; so that their eggs are thus kept warm, and also entirely concealed.

All the tribe of female moths lay their eggs a short time after they leave the aurelia; but there are many butterflies that flutter about the whole summer, and do not think of laying till the winter begins to warn them of their approaching end: some even continue the whole winter in the hollows of trees, and do not provide for posterity until the beginning of April, when they leave their retreats, deposit their eggs, and yield up their life. Their eggs soon begin to feel the genial influence of the season: the little animals burst from them in their caterpillar state, to become aurelias and butterflies in their turn; and thus to continue the round of nature.

OF THE ENEMIES OF THE CATERPILLAR.

Nature, though it has rendered some animals surprisingly fruitful, yet ever takes care to prevent their too great increase. One set of creatures is generally opposed to another: and those are chiefly the most prolific that are from their imbecility incapable of making any effectual defence. The caterpillar has perhaps of all other animals the greatest number of enemies; and seems only to exist by its surprising fecundity. Some animals devour them by hundreds; others, more minute, yet more dangerous, mangle them in various ways; so that, how great soever their numbers may be, their destroyers are in equal proportion. Indeed, if we consider the mischiefs these reptiles are capable of occasioning, and the various damages we sustain from their insatiable rapacity, it is happy for the other ranks of nature, that there are thousands of fishes, birds, and even insects, that live chiefly upon caterpillars, and make them their most favourite repast.

When we describe the little birds that live in our gardens, and near our houses, as destructive neighbours, sufficient attention is not paid to the services which they are frequently found to render us. It has been proved, that a single sparrow and its mate, that have young ones, destroy above three thousand caterpillars in a week; not to mention several butterflies, in which numberless caterpillars are destroyed in embryo. It is in pursuit of these reptiles that we are favoured with the visits of many of our most beautiful songsters; that amuse us during their continuance, and leave us when the caterpillars disappear.

The maxim, which has often been urged against man, that he, of all other animals, is the only creature that is an enemy to his own kind, and that the human species only are found to destroy each other, has been adopted by persons who never considered the history of insects. Some of the caterpillar kind, in particular, that seem fitted only to live upon leaves and plants, will, however, eat each other; and the strongest will devour the weaker in preference to their vegetable food. That which lives upon the oak is found to seize any of its companions, which it conveniently can, by the first rings, and inflict a deadly wound; it then feasts in tranquillity on its prey, and leaves nothing of the animal but the husk.

It is not, however, from each other that they have the most to fear, as in general they are inoffensive; and many of this tribe are found to live in a kind of society. Many sorts of flies lay their eggs either upon, or within their bodies; and as these turn into worms, the caterpillar is seen to nourish a set of intestine enemies within its body, that must shortly be its destruction: nature having taught flies, as well as all other animals, the surest methods of perpetuating their kind. 'Towards the end of August,' says Reaumur, 'I perceived a little fly, of a beautiful gold colour, busily employed in the body of a large caterpillar, of that kind which feeds upon cabbage. I gently separated that part of the leaf on which these insects were placed, from the rest of the plant, and placed it where I might observe them more at my ease. The fly, wholly taken up by the business in which it was employed, walked along the caterpillar's body, now and then remaining fixed to a particular spot. Upon this occasion, I perceived it every now and then dart a sting, which it carried at the end of its tail, into the caterpillar's body, and then draw it out again, to repeat the same operation in another place. It was not difficult for me to conjecture the business which engaged this animal so earnestly; its whole aim was to deposit its eggs in the caterpillar's body; which was to serve as a proper retreat for bringing them to perfection. The reptile thus rudely treated, seemed to bear all very patiently, only moving a little when stung too deeply; but which the fly seemed entirely to disregard. I took particular care to feed this caterpillar; which seemed to me to continue as voracious and vigorous as any of the rest of this kind. In about ten or twelve days, it changed into an aurelia, which seemed gradually to decline, and died: upon examining its internal parts, the animal was entirely devoured by worms; which, however, did not come to perfection, as it is probable they had not enough to sustain them within.'

What the French philosopher perceived upon this occasion, is every day to be seen in several of the larger kinds of caterpillars, whose bodies serve as a nest to various flies, that very carefully deposit their eggs within them. The large cabbage caterpillar is so subject to its injuries that, at certain seasons, it is much easier to find them with than without them. The ichneumon fly, as it is called, particularly infects these reptiles, and prevents their fecundity. This fly is, of all others, the most formidable to insects of various kinds. The spider, that destroys the ant, the moth, and the butterfly, yet often falls a prey to the ichneumon; who pursues the robber to his retreat, and, despising his nets, tears him in pieces, in the very labyrinth he has made to ensnare others. This insect, as redoubtable as the little quadruped that destroys the crocodile, has received the same name; and from its destruction of the caterpillar tribe, is probably more serviceable to mankind. This insect, I say, makes the body of the caterpillar the place for depositing its eggs; to the number of ten, fifteen, or twenty. As they are laid in those parts which are not mortal, the reptile still continues to live, and to feed, showing no signs of being incommoded by its new guests. The caterpillar changes its skin; and sometimes undergoes the great change into an aurelia: but still the fatal intruders work within, and secretly devour its internal substance: shortly after they are seen bursting through its skin, and moving away, in order to spin themselves a covering, previous to their own little transformation. It is indeed astonishing sometimes to see the number of worms, and those pretty large, that thus issue from the body of a single caterpillar, and eat their way through its skin: but it is more extraordinary still, that they should remain within the body, devouring its entrails, without destroying its life. The truth is, they seem instructed by Nature not to devour its vital parts; for they are found to feed only upon that fatty substance of which the largest part of the caterpillar's body is composed. When this surprising appearance was first observed, it was supposed that the animal thus gave birth to a number of flies, different from itself; and that the same caterpillar sometimes bred an ichneumon, and sometimes a butterfly: but it was not till after more careful inspection it was discovered, that the ichneumon tribe were not the caterpillar's offspring, but its murderers.

OF THE SILKWORM.

We have mentioned in the last chapter, the damages inflicted by the caterpillar tribe, but we are now to describe an animal of this kind, that alone compensates for all the mischief occasioned by the rest. This little creature, which only works for itself, has been made of the utmost service to man; and furnishes him with a covering more beautiful than any other animal can supply. We may declaim indeed against the luxuries of the times, when silk is so generally worn; but were such garments to fail, what other arts could supply their deficiency?

Though silk was in ancient times brought in small quantities to Rome, yet it was so scarce as to be sold for its weight in gold; and was considered as such a luxurious refinement in dress, that it was infamous for a man to appear in habits of which silk formed but half the composition. It was most probably brought among them from the remotest parts of the east; since it was, at the time of which I am speaking, scarcely known even in the Persian empire.

Nothing can be more remote from the truth, than the manner in which some historians have described the animal from which silk is produced. Pausanius informs us, that silk came from the country of the Seres, a people of Asiatic Scythia; in which place an insect, as large as the beetle, but in every other respect resembling a spider, was bred up for that purpose. They take great care, as he assures us, to feed and defend this insect from the weather; as well during the heat of the summer, as the rigours of winter. This insect, he observes, makes its web with its feet, of which it has eight in number. It is fed for the space of four years upon a kind of paste, prepared for it; and at the beginning of the fifth, it is supplied with the leaves of the green willow, of which it is particularly fond. It then feeds till it bursts with fat; after which they take out its bowels, which are spun into the beautiful manufacture so scarce and so costly.

The real history of this animal was unknown among the Romans till the time of Justinian; and it is supposed, that silkworms were not brought into Europe till the beginning of the twelfth century; when Roger of Sicily brought workmen in this manufacture from Asia Minor, after his return from his expedition to the Holy Land, and settled them in Sicily and Calabria. From these the other kingdoms of Europe learned this manufacture; and it is now one of the most lucrative carried on among the southern provinces of Europe. England was indebted to the persecutions carried on in France against the Protestants for its introduction, many of whom left their country and settled in this.

The silkworm is now very well known to be a large caterpillar, of a whitish colour, with twelve feet, and producing a butterfly of the moth kind. The cone on which it spins, is formed for covering it while it continues in the aurelia state; and several of these, properly wound off, and united together, form those strong and beautiful threads, which are woven into silk. The feeding these worms, the gathering, the winding, the twisting, and the weaving their silk, is one of the principal manufactures of Europe; and, as our luxuries increase, seems every day to become more and more necessary to human happiness.

There are two methods of breeding silkworms; for they may be left to grow, and to remain at liberty upon the trees where they are hatched; or they may be kept in a place built for that purpose, and fed every day with fresh leaves. The first method is used in China, Tonquin, and other hot countries; the other is used in those places where the animal has been artificially propagated, and still continues a stranger. In the warm climates, the silkworm proceeds from an egg, which has been glued by the parent moth upon proper parts of the mulberry-tree, and which remains in that situation during the winter. The manner in which they are situated and fixed to the tree, keeps them unaffected by the influence of the weather; so that those frosts which are severe enough to kill the tree, have no power to injure the silkworm.

The insect seldom or never proceeds from the egg till Nature has provided it a sufficient supply; and till the budding leaves are furnished, in a sufficient abundance, for its support. When the leaves are put forth, the worms seem to feel the genial summons, and bursting from their little eggs, crawl upon the leaves, where they feed with a most voracious appetite. Thus they become larger by degrees; and after some months feeding, they lay, upon every leaf, small bundles, or cones of silk, which appear like so many golden apples, painted on a fine green ground. Such is the method of breeding them in the East; and without doubt it is best for the worms, and least troublesome for the feeder of them. But it is otherwise in our colder European climates; the frequent changes of the weather, and the heavy dews of our evenings, render the keeping them all night exposed, subject to so many inconveniences, as to admit of no remedy. It is true, that, by the assistance of nets, they may be preserved from the insults of birds; but the severe cold weather, which frequently succeeds the first heats of summer, as well as the rain and high winds, will destroy them all: and, therefore, to breed them in Europe, they must be sheltered and protected from every external injury.

For this purpose, a room is chosen, with a south aspect; and the windows are so well glazed, as not to admit the least air: the walls are well built, and the planks of the floor exceedingly close, so as to admit neither birds nor mice, nor even so much as an insect. In the middle there should be four pillars erected, or four wood posts, so placed as to form a pretty large square. Between these are different stories made with osier hurdles; and under each hurdle there should be a floor, with an upright border all round. These hurdles and floors must hang upon pullies, so as to be placed or taken down at pleasure.

When the worms are hatched, some tender mulberry leaves are provided, and placed in the cloth or paper box in which the eggs were laid, and which are large enough to hold a great number. When they have acquired some strength, they must be distributed on beds of mulberry leaves, in the different stories of the square in the middle of the room, round which a person may freely pass on every side. They will fix themselves to the leaves, and afterwards to the sticks of the hurdles, when the leaves are devoured. They have then a thread, by which they can suspend themselves on occasion, to hinder any shock by a fall; but this is by no means to be considered as the silk which they spin afterwards in such abundance. Care must be taken that fresh leaves be brought every morning, which must be strewed very gently and equally over them; upon which the silkworms will forsake the remainder of the old leaves, which must be carefully taken away, and every thing kept exceedingly clean; for nothing hurts these insects so much as moisture and uncleanliness. It is for this reason that their leaves must be gathered when the weather is dry, and kept in a dry place, if it be necessary to lay in a store. As these animals have but a short time to live, they make use of every moment, and are almost continually spinning, except at those intervals when they change their skins. If mulberry leaves be difficult to be obtained, the leaves of lettuce or holyoak will sustain them; but they do not thrive so well upon their new diet; and their silk will neither be so copious, nor of so good a quality.

Though the judicious choice and careful management of their diet is absolutely necessary, yet there is another precaution of equal importance, which is, to give them air, and open their chamber windows, at such times as the sun shines warmest. The place also must be kept as clean as possible; not only the several floors that are laid to receive their ordure, but the whole apartments in general. These things well observed, contribute greatly to their health and increase.

The worm, at the time it bursts the shell, is extremely small, and of a black colour; but the head is of a more shining black than the rest of the body: some days after, they begin to turn whitish, or of an ash-coloured grey. After the skin begins to grow too rigid, or the animal is stinted within it, the insect throws it off, and appears clothed anew: it then becomes larger and much whiter, though it has a greenish cast: after some days, which are more or less, according to the different heat of the climate, or to the quality of the food, it leaves off eating, and seems to sleep for two days together: then it begins to stir, and put itself into violent motions, till the skin falls off the second time, and is thrown aside by the animal's feet. All these changes are made in three weeks or a month's time; after which it begins to feed once more, still in its caterpillar form, but a good deal differing from itself before its change. In the course of a few days it seems to sleep again; and, when it awakes, it again changes its clothing, and continues feeding as before. When it has thus taken a sufficiency of food, and its parts are disposed for assuming the aurelia form, the animal forsakes, for the last time, all food and society, and prepares itself a retreat to defend it from external injuries, while it is seemingly deprived of life and motion.

This retreat is no other than its cone, or ball of silk, which Nature has taught it to compose with great art; and within which it buries itself, till it assumes its winged form. This cone or ball is spun from two little longish kinds of bags that lie above the intestines, and are filled with a gummy fluid, of a marigold colour. This is the substance of which the threads are formed; and the little animal is furnished with a surprising apparatus for spinning it to the degree of fineness which its occasions may require. This instrument in some measure resembles a wire-drawer's machine, in which gold or silver threads are drawn to any degree of minuteness; and through this the animal draws its thread with great assiduity. As every thread proceeds from two gum bags, it is probable that each supplies its own; which, however, are united, as they proceed from the animal's body If we examine the thread with a microscope, it will be found that it is flatted on one side, and grooved along its length: whence we may infer, that it is doubled just upon leaving the body; and that the two threads stick to each other by that gummy quality of which they are possessed. Previous to spinning its web, the silkworm seeks out some convenient place to erect its cell, without any obstruction. When it has found a leaf, or a chink fitted to its purpose, it begins to wreathe its head in every direction, and fastens its thread on every side to the sides of its retreat. Though all its first essays seem perfectly confused, yet they are not altogether without design: there appears, indeed, no order or contrivance in the disposal of its first threads; for they are by no means laid artfully over each other, but are thrown out at random, to serve as an external shelter against rain; and Nature having appointed the animal to work upon trees in the open air, its habits remain, though it is brought up in a warm apartment.

Malpighi pretends to have observed six different layers in a single cone of silk: but what may easily be observed is, that it is composed externally of a kind of rough cotton-like substance, which is called floss; within the thread is more distinct and even; and next the body of the aurelia, the apartment seems lined with a substance of the hardness of paper, but of a much stronger consistence. It must not be supposed, that the thread which goes to compose the cone, is rolled round, as we roll a bottom; on the contrary, it lies upon it in a very irregular manner, and winds off now from one side of the cone, and then from the other. This whole thread, if measured, will be found about three hundred yards long; and so very fine, that eight or ten of them are generally rolled off into one by the manufacturers. The cone, when completed, is in form like a pigeon's egg, and more pointed at one end than the other; at the smaller end, the head of the aurelia is generally found; and this is the place which the insect, when converted into a moth, is generally seen to burst through.

It is about a fortnight or three weeks before the aurelia is changed into a moth; but no sooner is the winged insect completely formed, than, having divested itself of its aurelia skin, it prepares to burst through its cone, or outward prison: for this purpose it extends its head towards the point of the cone, butts with its eyes, which are rough, against the lining of its cell, wears it away, and at last pushes forward, through a passage which is small at first, but which enlarges as the animal increases its efforts for emancipation; while the tattered remnants of its aurelia skin lie in confusion within the cone, like a bundle of dirty linen.

When the animal is thus set free from its double confinement, it appears exhausted with fatigue, and seems produced for no other purpose but to transmit a future brood. It neither flies nor eats; the male only seeking the female, whose eggs he impregnates; and their union continues for four days, without interruption. The male dies immediately after separation from his mate; and she survives him only till she has laid her eggs, which are not hatched into worms till the ensuing spring.

However, there are few of these animals suffered to come to a state of maturity; for as their bursting through the cone destroys the silk, the manufacturers take care to kill the aurelia by exposing it to the sun, before the moth comes to perfection. This done, they take off the floss, and throw the cones into warm water, stirring them till the first thread offers them a clue for winding all off. They generally take eight of the silken threads together: the cones still kept under water till a proper quantity of the silk is wound off: but they do not take all; for the latter parts grow weak, and are of a bad colour. As to the paper-like substance which remains, some stain it with a variety of colours, to make artificial flowers; others, let it lie in the water, till the glutinous matter which cements it is all dissolved; it is then carded like wool, spun with a wheel, and converted into silk stuffs of an inferior kind.

INSECTS OF THE FOURTH ORDER.

OF THE FOUTH ORDER OF INSECTS IN GENERAL.

In the foregoing part we treated of caterpillars changing into butterflies; in the present will be given the history of grubs changing into their corresponding winged animals. These, like the former, undergo their transformation, and appear as grubs or maggots, as aurelias, and at last as winged insects. Like the former, they are bred from eggs; they feed in their reptile state; they continue motionless and lifeless, as aurelias: and fly and propagate when furnished with wings. But they differ in many respects; the grub or maggot wants the number of feet which the caterpillar is perceived to have; the aurelia is not so totally wrapped up, but that its feet and its wings appear. The perfect animal, when emancipated, also has its wings either cased, or transparent, like gauze; not coloured with that beautifully painted dust which adorns the wings of the butterfly.

In this class of insects, therefore, we may place a various tribe, that are first laid as eggs, then are excluded as maggots or grubs, then change into aurelias, with their legs and wings not wrapped up, but appearing; and, lastly, assuming wings, in which state they propagate their kind. Some of these have four transparent wings, as bees; some have two membranous cases to their wings, as beetles; and some have but two wings, which are transparent, as ants. Here, therefore, we shall place the bee, the wasp, the humble bee, the ichneumon fly, the gnat, the tipula or long-legs, the beetle, the may-bug, the glow-worm, and the ant. The transformation which all these undergo, are pretty nearly similar; and though very different animals in form, are yet produced nearly in the same manner.

OF THE BEE.

To exhibit a complete history of this insect in a few pages, which some have exhausted volumes in describing, and whose nature and properties still continue in dispute, is impossible. It will be sufficient to give a general idea of the animal's operations; which, though they have been studied for more than two thousand years, are still but incompletely known. The account given us by Reaumur is sufficiently minute; and, if true, sufficiently wonderful: but I find many of the facts which he relates, doubted by those who are most conversant with bees; and some of them actually declared not to have a real existence in Nature.

It is unhappy, therefore, for those whose method demands a history of bees, that they are unfurnished with those materials which have induced so many observers to contradict so great a naturalist. His life was spent in the contemplation; and it requires an equal share of attention, to prove the error of his discoveries. Without entering, therefore, into the dispute, I shall take him for my guide; and just mention, as I go along, those particulars in which succeeding observers have begun to think him erroneous. Which of the two are right, time can only discover; for my part, I have only heard one side, for as yet none have been so bold as openly to oppose Reaumur's delightful researches.

There are three different kinds of bees in every hive. First, the labouring bees, which make up by far the greatest number, and are thought to be neither male nor female, but merely born for the purposes of labour, and continuing the breed, by supplying the young with provision, while yet in their helpless state. The second sort are the drones; they are of a darker colour, longer, and more thick by one-third than the former; they are supposed to be the males; and there is not above a hundred of them in a hive of seven or eight thousand bees. The third sort is much larger than either of the former, and still fewer in number: some assert that there is not above one in every swarm: but this later observers affirm not to be true, there being sometimes five or six in the same hive. These are called queen bees, and are said to lay all the eggs from which the whole swarm is hatched in a season.

In examining the structure of the common working bee, the first remarkable part that offers is the trunk, which serves to extract the honey from flowers. It is not formed like that of other flies, in the manner of a tube, by which the fluid is to be sucked up; but like a besom to sweep, or a tongue, to lick it away. The animal is furnished also with teeth, which serve it in making wax. This substance is gathered from flowers, like honey; it consists of that dust or farina which contributes to the fecundation of plants, and is moulded into wax by the little animal at leisure. Every bee when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantities of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower and soon becomes quite covered with the dust, which it shortly after brushes off with its two hind legs and kneads into two little balls. In the thighs of the hind legs there are two cavities, edged with hair, and into these, as into a basket, the animal sticks its pellets. Thus employed, the bee flies from flower to flower, increasing its store, and adding to its stock of wax; until the ball upon each thigh becomes as big as a grain of pepper: by this time, having got a sufficient load, it returns, making the best of its way to the hive.

The belly of the bee is divided into six rings, which sometimes shorten the body, by slipping one over the other. It contains within it, beside the intestines, the honey-bag, the venom-bag, and the sting. The honey-bag is as transparent as crystal, containing the honey that the bee has brushed from the flowers; of which the greater part is carried to the hive, and poured into the cells of the honey-comb; while the remainder serves for the bee's own nourishment: for, during summer, it never touches what has been laid up for the winter. The sting, which serves to defend this little animal from its enemies, is composed of three parts; the sheath and two darts, which are extremely small and penetrating. Both the darts have several small points or barbs, like those of a fish-hook, which render the sting more painful, and makes the darts rankle in the wound. Still, however, this instrument would be very slight, did not the bee poison the wound. The sheath, which has a sharp point, makes the first impression; which is followed by that of the darts, and then the venomous liquor is poured in. The sheath sometimes sticks so fast in the wound, that the animal is obliged to leave it behind; by which the bee soon after dies, and the wound is considerably inflamed. It might at first appear well for mankind, if the bee were without its sting; but upon recollection, it will be found that the little animal would have then too many rivals in sharing its labours. A hundred other lazy animals, fond of honey, and hating labour, would intrude upon the sweets of the hive; and the treasure would be carried off for want of armed guardians to protect it.

From examining the bee singly, we are next to consider it in society, as an animal not only subject to laws, but active, vigilant, laborious, and disinterested. All its provisions are laid up for the community; and all its arts in building a cell designed for the benefit of posterity. The substance with which bees build their cells is wax; which is fashioned into convenient apartments for themselves and their young. When they begin to work in their hives, they divide themselves into four companies: one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of their cells; a third is employed in making the inside smooth from the corners and angles; and the fourth company bring food for the rest, or relieve those who return with their respective burdens. But they are not kept constantly to one employment; they often change the tasks assigned them: those that have been at work, being permitted to go abroad; and those that have been in the fields already take their places. They seem even to have signs, by which they understand each other; for when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the other's mouth, which is at that time open to receive it. Their diligence and labour is so great, that in a single day's time they are able to make cells which lie upon each other, numerous enough to contain three thousand bees.

If we examine their cells, they will be found formed in the exactest proportion. It was said by Pappus, an ancient geometrician, that, of all other figures, hexagons were the most convenient; for when placed touching each other, the most convenient room would be given, and the smallest lost. The cells of the bees are perfect hexagons: these, in every honey-comb, are double, opening on either side, and closed at the bottom. The bottoms are composed of little triangular panes, which, when united together, terminate in a point, and lie exactly upon the extremities of other panes of the same shape, in opposite cells. These lodgings have spaces, like streets, between them, large enough to give the bees a free passage in and out; and yet narrow enough to preserve the necessary heat. The mouth of every cell is defended by a border, which makes the door a little less than the inside of the cell, which serves to strengthen the whole.

These cells serve for different purposes: for laying up their young; for their wax, which in winter becomes a part of their food; and for their honey, which makes their principal subsistence.

It is a fact pretty well known, that the habitation of bees should be very close; and what their hives want, from the negligence or unskilfulness of man, these animals supply by their own natural industry: so that it is their principal care, when first hived, to stop up all the crannies. For this purpose they make use of a resinous gum, which is more tenacious than wax, and differs greatly from it. This the ancients called *propolis*: it will grow considerably hard in June; though it will in some measure soften by heat; and is often found different in consistence, colour, and smell. It has generally an agreeable aromatic odour when it is warmed; and by some it is considered as a most grateful perfume. When the bees begin to work with it, it is soft, but it acquires a firmer consistence every day; till at length it assumes a brown colour, and becomes much harder than wax. The bees carry it on their hinder legs; and some think it is met with on the birch, the willow, and poplar. However it is procured, it is certain that they plaster the inside of their hives with this composition.

If examined through a glass hive, from the hurry the whole swarm is in, the whole appears at first like a state of anarchy and confusion: but the spectator soon perceives that every animal is diligently employed, and following one pursuit, with a determined purpose. Their teeth are the instruments by which they model and fashion their various buildings, and give them such symmetry and perfection. They begin at the top of the hive, and several of them work at a time at the cells, which have two faces. If they are stinted with regard to time, they give the new cells but half the depth which they ought to have; leaving them imperfect, till they have sketched out the number of cells necessary for the present occasion. The construction of their combs costs them a great deal of labour: they are made by insensible additions; and not cast at once in a mould, as some are apt to imagine. There seems, indeed, no end of their shaping, finishing, and turning them neatly up. The cells for their young are most carefully formed; those designed for lodging the drones are larger than the rest; and that for the queen-bee, the largest of all. The cells in which the young brood are lodged, serve at different times for containing honey; and this proceeds from an obvious cause: every worm, before it is transformed into an aurelia, hangs its old skin on the partitions of its cell; and thus, while it strengthens the wall, diminishes the capacity of its late apartment. The same cell, in a single summer, is often tenanted by three or four worms in succession; and the next season, by three or four more. Each worm takes peculiar care to fortify the pannels of its cell, by hanging up its spoils there: thus, the partitions being lined, six or eight deep, become at last too narrow for a new brood, and are converted into store-houses for honey.

Those cells, where nothing but honey is deposited, are much deeper than the rest. When the harvest of honey is so plentiful that they have not sufficient room for it, they either lengthen their combs, or build more; which are considerably longer than the former. Sometimes they work at three combs at a time; for when there are three work-houses, more bees may be thus employed, without embarrassing each other.

But honey, as was before observed, is not the only food upon which these animals subsist. The meal of flowers, of which their wax is formed, is one of their most favourite repasts. This is a diet which they live upon during the summer; and of which they lay up a large store for winter provision. The wax of which their combs are made, is no more than this meal digested, and wrought into a kind of paste. When the flowers upon which bees generally feed, are not fully blown, and this meal or dust is not offered in sufficient quantities, the bees pinch the tops of the stamina in which it is contained, with their teeth; and thus anticipate the progress of vegetation. In April and May, the bees are busy, from morning to evening, in gathering this meal; but when the weather becomes too hot, as it does in the midst of summer, they work only in the morning.

The bee is furnished with a stomach for its wax, as well as its honey. In the former of the two, their powder is altered, digested, and concocted into real wax; and is thus ejected through the same passage by which it was swallowed. Every comb, newly made, is white: but it becomes yellow as it acquires age, and almost black when kept too long in the hive. Beside the wax thus digested, there is a large portion of the powder kneaded up for food in every hive, which is kept in separate cells for winter provision. This is called, by the country people, bee-bread; and contributes to the health and strength of the animal during winter. Those who rear bees, may rob them of their honey, and feed them, during the winter, with treacle; but no proper substitute has yet been found for the bee-bread; and, without it, the animals become consumptive and die.

As for the honey, it is extracted from that part of the flower called the nectareum. From the mouth this delicious fluid passes into the gullet; and then into the first stomach, or honey-bag, which, when filled, appears like an oblong bladder; children that live in country places are well acquainted with this bladder, and destroy many bees to come at their store of honey. When a bee has sufficiently filled its first stomach, it returns back to the hive, where it disgorges the honey into one of the cells. It frequently happens that the bee delivers its store to some other, at the mouth of the hive, and flies off to obtain a fresh supply.

Some honey-combs are always left open for common use; but many others are stopped up, till there is a necessity of opening them. Each of these are covered carefully with wax; so closely, that the covers seem to be made at the very instant the fluid is deposited within them.

Having thus given a cursory description of the insect, individually considered, and of the habitation it forms, we next come to its social habits and institutions: and, in considering this little animal attentively, after the necessary precautions for the immediate preservation of the community, its second care is turned to the continuance of posterity. How numerous soever the multitude of bees may appear in one swarm, yet they all owe their origin to a single parent, which is called the *Queen-Bee.* It is indeed surprising that a single insect shall, in one summer, give birth to above twenty thousand young: but, upon opening her body, the wonder will cease; as the number of eggs appearing, at one time, amounts to five thousand. This animal, whose existence is of such importance to her subjects, may easily be distinguished from the rest, by her size, and the shape of her body. On her safety depends the whole welfare of the commonwealth; and the attentions paid her by all the rest of the swarm, evidently show the dependence her subjects have upon her security. If this insect be carefully observed, she will be seen at times attended with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many of them, and leaving a small egg in each.

The bees which generally compose her train, are thought to be males, which serve to impregnate her by turns. These are larger and blacker than the common bees; without stings, and without industry. They seem formed only to transmit a posterity; and to attend the queen, whenever she thinks proper to issue from the secret retreats of the hive, where she most usually resides. Upon the union of these two kinds depends all expectations of a future progeny; for the working bees are of no sex, and only labour for another offspring: yet such is their peculiar attention to their queen, that if she happens to die, they will leave off working, and take no farther care of posterity. If, however, another queen is, in this state of universal despair, presented them, they immediately acknowledge her for their sovereign, and once more diligently apply to their labour. But, it must be observed, that all this fertility of the queen-bee, and the great attentions that are paid to her by the rest, are controverted by more recent observers. They assert, that the common bees are parents themselves; that they deposit their eggs in the cells which they have prepared; that the females have intercourse with the males, and bring forth a progeny, which is wholly their own.

However, to proceed with their history, as delivered to us by M. Reaumur. When the queen-bee has deposited the number of eggs necessary in the cells, the working bees undertake the care of the rising posterity. They are seen to leave off their usual employments; to construct proper recepticles for eggs; or to complete those that are already formed. They purposely build little cells, extremely solid, for the young: in which they employ a great deal of wax: those designed for lodging the males, as was already observed, are somewhat larger than the rest; and those for the queen-bees the largest of all. There is usually but one egg deposited in every cell; but when the fecundity of the queen is such, that it exceeds the number of cells already prepared, there are sometimes three or four eggs crowded together in the same apartment. But this is an inconvenience that the working bees will by no means suffer. They seem sensible that two young ones, stuffed up in the same cell, when they grow larger, will but embarrass, and at last destroy each other; they therefore take care to leave a cell to every egg; and remove, or destroy the rest.

The solitary egg that is left remaining, is fixed to the bottom of the cell, and touches it but in a single point. A day or two after it is deposited, the worm is excluded from the shell of the egg, having the appearance of a maggot rolled up in a ring, and lying softly on a bed of a whitish coloured jelly; upon which also the little animal begins to subsist. In the mean time, the instant it appears, the working bees attend it with the most anxious and parental tenderness; they furnish it every hour with a supply of this whitish substance, on which it feeds and lies; and watch the cell with unremitting care. They are nurses that have greater affection for the offspring of others, than many parents have for their own children. They are remarkably constant in visiting each cell, and seeing that nothing is wanting; preparing the white mixture, which is nothing but a composition of honey and wax, in their own bowels, with which they feed them. Thus attended, and plentifully fed, the worm, in less than six days time, arrives at its full growth, and no longer accepts the food offered it. When the bees perceive that it has no further occasion for feeding, they perform the last offices of tenderness, and shut the little animal up in its cell; walling up the mouth of its apartment with wax; where they leave the worm to itself; having secured it from every external injury.

The worm is no sooner left enclosed, but, from a state of inaction, it begins to labour, extending and shortening its body; and by this means lining the walls of its apartment with a silken tapestry, which it spins in the manner of caterpillars, before they undergo their last transformation. When their cell is thus prepared, the animal is soon after transformed into an aurelia; but differing from that of the common caterpillar, as it exhibits not only the legs, but the wings of the future bee, in its present state of inactivity. Thus, in about twenty, or one and twenty days after the egg was laid, the bee is completely formed, and fitted to undergo the fatigues of its state. When all its parts have acquired their proper strength and consistence, the young animal opens its prison, by piercing with its teeth the waxen door that confines it. When just free from its cell, it is as yet moist, and incommoded with the spoils of its former situation; but the officious bees are soon seen to flock round it, and to lick it clean on all sides with their trunks; while another band, with an equal share of assiduity, are observed to feed it with honey: others again begin immediately to cleanse the cell that has been just left; to carry the ordures out of the hive, and to fit the place for a new inhabitant. The young bee soon repays their care by its industry; for no sooner do its external parts become dry, than it discovers its natural appetites for labour, and industriously begins the task, which it pursues unremittingly through life. The toil of man is irksome to him, and he earns his subsistence with pain; but this little animal seems happy in its pursuits, and finds delight in all its employments.

When just freed from the cell, and properly equipped by its fellow bees for duty, it at once issues from the hive, and instructed only by nature, goes in quest of flowers, chooses only those that yield it a supply, rejects such as are barren of honey, or have been already drained by other adventurers; and when loaded, is never at a loss to find its way back to the common habitation. After this first sally it begins to gather the mealy powder that lies on every flower, which is afterwards converted into wax; and with this, the very first day, it returns with two large balls stuck to its thighs.

When bees first begin to break their prisons, there are generally above a hundred excluded in one day. Thus, in the space of a few weeks, the number of the inhabitants in one hive, and that of a moderate size, becomes so great, that there is no place to contain the new comers; and they are scarcely excluded from the cell before they are obliged by the old bees to sally forth in quest of new habitations. In other words the hive begins to swarm, and the new progeny prepares for exile.

While there is room enough in the hive, the bees remain quietly together; and it is necessity alone that compels the separation. Sometimes, indeed, the young brood, with graceless obstinacy, refuse to depart, and even venture to resist their progenitors. The young ones are known by being browner than the old, with whiter hair; the old ones are of a lighter colour, with red hair. The two armies are therefore easily distinguishable, and dreadful battles are frequently seen to ensue. But the victory almost always terminates with strict poetical justice in favour of the veterans, and the rebellious offspring are driven off, not without loss and mutilation.

In different countries the swarms make their appearance at different periods of the year, and there are several signs previous to this intended migration. The night before an unusual buzzing is heard in the hive; in the morning, though the weather be soft and inviting, they seem not to obey the call, being intent on more important meditations within. All labour is discontinued in the hive, every bee is either employed in forcing, or reluctantly yielding a submission; at length, after some noise and tumult, a queen bee is chosen to guard rather than conduct the young colony to other habitations, and then they are marshalled without any apparent conductor. In less than a minute they leave their native abode, and forming a cloud round their protectress, they set off, without seeming to know the place of their destination; *The world before them, where to choose their place of rest.* The usual time of swarming is from ten in the morning to three in the afternoon, when the sun shines bright, and invites them to seek their fortunes. They flutter for a while in the air, like flakes of snow, and sometimes undertake a distant journey, but more frequently are contented with some neighbouring asylum; the branch of a tree, a chimney-top, or some other exposed situation. It is indeed remarkable, that all these animals, of whatever kind, that have long been under the protection of man, seem to lose a part of their natural sagacity in providing for themselves. The rabbit, when domesticated, forgets to dig holes, the hen to build a nest, and the bee to seek a shelter that may protect it from the inclemencies of winter. In those countries where the bees are wild, and unprotected by man, they are always sure to build their waxen cells in the hollow of a tree; but with us they seem improvident in their choice, and the first green branch that stops their flight seems to be thought sufficient for their abode through winter. However, it does not appear that the queen chooses the place where they are to alight; for many of the stragglers, who seem to be pleased with a particular branch, go and settle upon it; others are seen to succeed; and at last the queen herself, when she finds a sufficient number there before her, goes to make it the place of her head quarters. When the queen is settled, the rest of the swarm quickly follow; and in about a quarter of an hour the whole body seem to be at ease. It sometimes is found, that there are two or three queens to a swarm, and the colony is divided into parties; but it most usually happens, that one of these is more considerable than the other, and the bees by degrees desert the weakest, to take shelter under the most powerful protector. The deserted queen does not long survive this defeat; she takes refuge under the new monarch, and is soon destroyed by her jealous rival. Till this cruel execution is performed, the bees never go out to work; and if there should be a queen bee belonging to the new colony left in the old hive, she always undergoes the fate of the former. However, it must be observed, that the bees never sacrifice any of their queens when the hive is full of wax and honey; for there is at that time no danger in maintaining a plurality of breeders.

The swarm being thus conducted to a place of rest, and the policy of government settled, the bees soon resume their former labours. The making cells, storing them with honey, impregnating the queen, making proper cells for the reception of the rising progeny, and protecting them from external danger, employ their unceasing industry. But soon after, and towards the latter end of summer, when the colony is sufficiently stored with inhabitants, a most cruel policy ensues. The drone bees, which are (as has been said) generally in a hive, to the number of a hundred, are marked for slaughter. These, which had hitherto led a life of indolence and pleasure, whose only employment was in impregnating the queen, and rioting upon the labours of the hive, without aiding in the general toil, now share the fate of most voluptuaries, and fall a sacrifice to the general resentment of society.

The working bees, in a body, declare war against them; and in two or three days time, the ground all round the hive is covered with their dead bodies. Nay, the working bees will even kill such drones, as are yet in the worm state, in the cell, and eject their bodies from the hive, among the general carnage.

When a hive sends out several swarms in the year, the first is always the best, and the most numerous. These, having the whole summer before them, have the more time for making wax and honey, and consequently their labours are the most valuable to the proprietor. Although the swarm chiefly consists of the youngest bees, yet it is often found, that bees of all ages compose the multitude of emigrants, and it often happens, that bees of all ages are seen remaining behind. The number of them is always more considerable than that of some populous cities, for sometimes upwards of forty thousand are discovered in a single hive. So large a body may well be supposed to work with great expedition; and, in fact, in less than twenty-four hours, they will make combs above twenty inches long, and seven or eight broad. Sometimes they will half fill their hives with wax in less than five days. In the first fifteen days, they are always observed to make more wax than they do afterwards during the rest of the year.

Such are the outlines of the natural history of these industrious animals, as usually found in our own country. How they are treated, so as to produce the greatest quantity of honey, belongs rather to the rural economist, than the natural historian; volumes have been written on the subject, and still more remains equally curious and new. One thing, however, it may be proper to notice, that a farm, or a country, may be over-stocked with bees, as well as with any other sort of animal; for a certain number of hives, always require a certain number of flowers to subsist on. When the flowers near home are rifled, then are these industrious insects seen taking more extensive ranges; but their abilities may be over-taxed; and if they are obliged, in quest of honey, to go too far from home, they are over-wearied in the pursuit, they are devoured by birds, or beat down by the winds and rain.

From a knowledge of this, in some parts of France and Piedmont, they have contrived a kind of floating bee-house. They have on board one barge threescore or a hundred bee-hives, which are well defended from the inclemency of an accidental storm; and with these the owners suffer themselves to float gently down the river.

As the bees are continually choosing their flowery pasture along the banks of the stream, they are furnished with sweets before unrifled; and thus a single floating bee-house yields the proprietor a considerable income. Why a method similar to this has never been adopted in England, where we have more gentle rivers, and more flowery banks, than in any other part of the world, is not known; certainly it might be turned to advantage, and yield the possessor a secure, though perhaps a moderate income.

Having mentioned the industry of these admirable insects, it will be proper to say a few words concerning the effects of their labour, we mean of that wax and honey which are turned by man to such various uses. Bees gather two kinds of wax, one coarse and the other fine. The coarser sort is bitter, and with this, which is called *propolis,* as we have before observed, they stop up all the holes and crevices of their hives. It is of a more resinous nature than the fine wax, and is consequently better qualified to resist the moisture of the season, and preserve the works warm and dry within. The fine wax is as necessary to the animal's preservation as the honey itself. With this they make their lodgings, with this they cover the cells of their young, and in this they lay up their magazines of honey. This is made, as has been already observed, from the dust of flowers, which is carefully kneaded by the little insect, then swallowed, and having undergone a kind of digestion, is formed into the cells, which answers such a variety of purposes. To collect this, the animal rolls itself in the flower it would rob, and thus takes up the vegetable dust with the hair of its body. Then carefully brushing it into a lump, with its fore-paws it thrusts the composition into two cavities behind the thighs, which are made like spoons to receive the wax, and the hair that lines them serves to keep it from falling.

As of wax, there are also two kinds of honey; the white and the yellow. The white is taken without fire from the honey-combs. The yellow is extracted by heat, and squeezed through bags in a press. The best honey is new, thick, and granulated, of a clear transparent white colour, of a soft and aromatic odour, and of a sweet and lively taste. Honey made in mountainous countries, is preferable to that of the valley. The honey made in the spring is more highly esteemed than that which is gathered in summer, which last is still more valuable than that of autumn, when the flowers begin to fade and lose their fragrance.

The bees are nearly alike in all parts of the world, yet there are differences worthy our notice. In the island of Guadaloupe the bee is less by one half than the European, and more black and round. They have no sting, and make their cells in hollow trees; where, if the hole they meet with is too large, they form a sort of waxen house of the shape of a pear, and in this they lodge and store their honey, and lay their eggs. They lay up their honey in waxen vessels, of the size of a pigeon's egg, of a black or deep violet colour; and these are so joined together, that there is no space left between them. The honey never congeals, but is fluid, of the consistence of oil, and the colour of amber. Resembling these, there are found little black bees, without a sting, in all the tropical climates; and though these countries are replete with bees, like our own, yet those form the most useful and laborious tribe in that part of the world. The honey they produce, is neither so unpalatable, nor so surfeiting as ours; and the wax is so soft, that it is only used for medicinal purposes, it being never found hard enough to form into candles, as in Europe.

Of insects, that receive the name of bees, among us, there are several; which, however, differ widely from that industrious, social race we have been just describing. The humble bee is the largest of all this tribe, being as large as the first joint of one's middle finger. These are observed in every field, and perched on every flower. They build their nest in holes in the ground, of dry leaves, mixed with wax and wool, defended with moss from the weather. Each humble-bee makes a separate cell about the size of a small nutmeg, which is round and hollow, containing the honey in a bag. Several of these cells are joined together, in such a manner, that the whole appears like a cluster of grapes. The females, which have the appearance of wasps, are very few, and their eggs are laid in cells, which the rest soon cover over with wax. It is uncertain whether they have a queen or not; but there is one much larger than the rest, without wings and without hair, and all over black, like polished ebony. This goes and views all the works, from time to time, and enters into the cell, as if it wanted to see whether every thing was done in a proper manner: in the morning, the young humble-bees are very idle, and seem not at all inclined to labour, till one of the largest, about seven o'clock, thrusts half its body from a hole designed for that purpose, and seated on the top of the nest, beats its wings for twenty minutes successively, buzzing the whole time, till the whole colony is put in motion. The humble bees gather honey, as well as the common bees; but it is neither so fine, nor so good, nor the wax so clean, or so capable of fusion.

Besides the bees already mentioned, there are various kinds among us, that have much the appearance of honey-makers, and yet make only wax. The wood bee is seen in every garden. It is rather larger than the common queen-bee; its body of a blueish black, which is smooth and shining. It begins to appear at the approach of spring, and is seen flying near walls exposed to a sunny aspect. This bee makes its nest in some piece of wood, which it contrives to scoop and hollow for its purpose. This, however, is never done in trees that are standing, for the wood it makes choice of is half rotten. The holes are not made directly forward, but turning to one side, and have an opening sufficient to admit one's middle finger, from whence runs the inner apartment, generally twelve or fifteen inches long. The instruments used in boring these cavities, are their teeth; the cavity is usually branched into three or four apartments; and in each of these they lay their eggs, to the number of ten or twelve, each separate and distinct from the rest: the egg is involved in a sort of paste, which serves at once for the young animal's protection and nourishment. The grown bees, however, feed upon small insects, particularly a louse, of a reddish brown colour, of the size of a small pin's head.

Mason bees make their cells with a sort of mortar made of earth, which they build against a wall that is exposed to the sun. The mortar, which at first is soft, soon becomes as hard as stone, and in this their eggs are laid. Each nest contains seven or eight cells, an egg in every cell, placed regularly one over the other. If the nest remain unhurt, or want but little repairs, they make use of them the year ensuing: and thus they often serve three or four years successively. From the strength of their houses, one would think these bees in perfect security, yet none are more exposed to danger than they. A worm with very strong teeth, is often found to bore into their little fortifications, and devour their young.

The ground-bee builds its nest in the earth, wherein they make round holes, five or six inches deep; the mouth being narrow, and only just sufficient to admit the little inhabitant.

It is indeed really amusing to observe the patience and assiduity with which they labour. They carry out all the earth, grain by grain, to the mouth of the hole, where it forms a little hillock; an Alps compared to the power of the artist by which it is raised. Sometimes the walks of a garden are found undermined by their labours; some of the holes running directly downward, others horizontally beneath the surface. They lay up in these cavities provisions for their young, which consist of a paste that has the appearance of corn, and is of a sweetish taste.

The leaf-cutting bees make their nest and lay their eggs among bits of leaves, very artificially placed in holes in the earth, of about the length of a tooth-pick case. They make the bits of leaves of a roundish form, and with them line the inside of their habitations. This tapestry is still further lined by a reddish kind of paste, somewhat sweet or acid. These bees are of various kinds; those that build their nests with chesnut leaves are as big as drones, but those of the rose-tree are smaller than the common bee.

The wall bees are so called because they make their nests in walls of a kind of silky membrane, with which they fill up the vacuities between the small stones that form the sides of their habitation. Their apartment consists of several cells placed end to end, each in the shape of a woman's thimble. Although the web which lines this habitation is thick and warm, yet it is transparent and of a whitish colour. This substance is supposed to be spun from the body of the animal. The males and females are of a size, but the former are without a sting. To these varieties of the bee kind might be added several others, which are all different in nature, but not sufficiently distinguished to excite curiosity.

OF THE WASP.

However similar many insects may be in appearance, this does not in the least imply a similitude in their history. The bee and the wasp resemble each other very strongly, yet in examining their manner and their duration, they differ very widely; the bee labours to lay up honey, and lives to enjoy the fruits of its industry; the wasp appears equally assiduous; but only works for posterity, as the habitation is scarcely completed when the inhabitant resigns its life.

The wasp is well known to be a winged insect with a sting; to be longer in proportion to its bulk than the bee, to be marked with bright yellow circles round its body, and to be the most swift and active insect of all the fly kind. On each side of the mouth this animal is furnished with a long tooth, notched like a saw, and with these it is enabled to cut any substance, not omitting meat itself, and to carry it to its nest. Wasps live like bees in community, and sometimes ten or twelve thousand are found inhabiting a single nest.

Of all other insects the wasp is the most fierce, voracious, and even dangerous, when enraged. They are seen wherever flesh is cutting up, gorging themselves with the spoil, and then flying to their nests with their reeking prey. They make war also on every other fly, and the spider himself dreads their approaches.

Every community among bees is composed of females or queens, drones or males, and neutral or working-bees. Wasps have similar occupations; the two first are for propagating the species, the last for nursing, defending, and supporting the rising progeny. Among bees, however, there is seldom above a queen or two in a hive; but among wasps there are sometimes above two or three hundred.

As soon as the summer begins to invigorate the insect tribes, the wasps are the most of the number, and diligently employed either in providing provisions for their nest, if already made, or in making one, if the former habitation be too small to receive the increasing community. The nest is one of the most curious objects in natural history, and contrived almost as artificially as that of the bees themselves. Their principal care is to seek out a hole that has been begun by some other animal, a field mouse, a rat, or a mole, to build their nests in. They sometimes build upon the plain, where they are sure of the dryness of their situation, but mostly on the side of a bank, to avoid the rain or water that would otherwise annoy them. When they have chosen a proper place, they go to work with wonderful assiduity. Their first labour is to enlarge and widen the hole, taking away the earth, and carrying it off to some distance. They are perfectly formed for labour, being furnished with a trunk above their mouths, two saws on each side, which play to the right and left against each other, and six strong muscular legs to support them. They cut the earth into small parcels with their saws, and carry it out with their legs or paws. This is the work of some days; and at length the outline of their habitation is formed, making a cavity of about a foot and a half every way. While some are working in this manner, others are roving the fields in search of materials for their building. To prevent the earth from falling down and crushing their rising city into ruin, they make a sort of roof with their gluey substance, to which they begin to fix the rudiments of their building, working from the top downwards, as if they were hanging a bell, which, however, at length they close at the bottom. The materials with which they build their nests are bits of wood and glue. The wood they get where they can from the rails and posts which they meet with in the fields and elsewhere. These they saw and divide into a multitude of small fibres, of which they take up little bundles in their claws, letting fall upon them a few drops of gluey matter, with which their bodies are provided, by the help of which they knead the whole composition into a paste, which serves them in their future erection. When they have returned with this to their nest, they stick their load of paste on that part where they make their walls and partitions; they tread it close with their feet, and trowel it with their trunks, still going backwards as they work. Having repeated this operation three or four times, the composition is at length flatted out until it becomes a small leaf of a grey colour, much finer than paper, and of a pretty firm texture. Having proceeded so far, the same wasp returns to the field to collect a second load of paste, repeating the same several times, placing layer upon layer, and strengthening every partition in proportion to the wants or convenience of the general fabric. Other working wasps come quickly after to repeat the same operation, laying more leaves upon the former, till at length, after much toil, they have finished the large roof which is to secure them from the tumbling in of the earth. This dome being completed, they make another entrance to their habitation, designed either for letting in the warmth of the sun, or for escaping in case one door be invaded by plunderers. It is however, certain, that by one of these they always enter, by the other they sally forth to their toil; each hole being so small that they can pass but one at a time. The walls being thus composed, and the whole somewhat of the shape of a pear, they labour at their cells, which they compose of the same paper-like substance that goes to the formation of the outside works. Their combs differ from those of bees, not less in the composition than in the position which they are always seen to obtain. The honey-comb of the bee is edgeways with respect to the hive; that of the wasp is flat, and the mouth of every cell opens downwards. Thus is their habitation contrived, story above story, supported by several rows of pillars which give firmness to the whole building, while the upper story is flat-roofed, and as smooth as the pavement of a room, laid with squares of marble. The wasps can freely walk upon these stories between the pillars to do whatever their wants require. The pillars are very hard and compact, being larger at each end than in the middle, not much unlike the columns of a regular building. All the cells of the nest are only destined for the reception of the young, being replete with neither wax nor honey.

Each cell is like that of the bee, hexagonal; but they are of two sorts, the one larger for the production of the male and female wasps, the other less for the reception of the working part of the community. When the females are impregnated by the males, they lay their eggs, one in each cell, and stick it in with a kind of gummy matter to prevent its falling out. From this egg proceeds the insect in its worm state, of which the old ones are extremely careful, feeding it from time to time till it becomes large and entirely fills up its cell. But the wasp community differs from that of the bee in this particular; that among the latter the working bees take the parental duties upon them, whereas among the wasps the females alone are permitted to feed their young, and to nurse their rising progeny. For this purpose the female waits with great patience till the working wasps have brought in their provisions, which she takes from them, and cuts into pieces. She then goes with great composure from cell to cell, and feeds every young one with her mouth. When the young worms have come to a certain size, they leave off eating, and begin to spin a very fine silk, fixing the first end to the entrance of the cell, then turning their heads, first on one side, then on the other, they fix the threads to different parts, and thus make a sort of a door, which serves to close up the mouth of the cell. After this they divest themselves of their skins according to the usual mode of transformation; the aurelia, by degrees, begins to emancipate itself from its shell; by little and little it thrusts out its legs and wings, and insensibly acquires the colour and shape of its parent.

The wasp thus formed, and prepared for depredation, becomes a bold, troublesome, and dangerous insect: there are no dangers which it will not encounter in pursuit of its prey, and nothing seems to satiate its gluttony; for though it can gather no honey of its own, no animal is more fond of sweets. For this purpose, it will pursue the bee and the humble bee, destroy them with its sting, and then plunder them of their honey-bag, with which it flies triumphantly loaded to its nest to regale its young. Wasps are ever fond of making their nests in the neighbourhood of bees, merely to have an opportunity of robbing their hives, and feasting on the spoil. Yet the bees are not found always patiently submissive to this kind of tyranny, but fierce battles are sometimes seen to ensue, in which the bees make up by conduct and numbers what they want in personal prowess. When there is no honey to be had, they seek for the best and sweetest fruits, and they are never mistaken in their choice. From the garden they fly to the city, to the grocers' shops, and butchers' shambles. They will sometimes carry off bits of flesh half as big as themselves, with which they fly to their nests for the nourishment of their brood. Those who cannot drive them away, lay for them a piece of ox's liver, which being without fibres, they prefer to other flesh; and whenever they are found, all other flies are seen to desert the place immediately. Such is the dread with which these little animals impress all the rest of the insect tribes, (which they seize and devour without mercy), that they vanish at their approach. Wherever they fly, like the eagle or the falcon, they form a desert in the air around them. In this manner the summer is passed in committing acts of plunder on the neighbourhood, and rearing up their young; every day adds to their numbers; and from their strength, agility, and indiscriminate appetite for every kind of provision, were they as long-lived as the bee, they would soon swarm upon the face of Nature, and become the most noxious plague of man; but Providence has otherwise ordained, and their lives are measured to their mischief, for they live but a single season.

While the summer heats continue, they are bold, voracious, and enterprising; but as the sun withdraws, it seems to rob them of their courage and activity. In proportion as the cold increases, they are seen to become more domestic; they seldom leave the nest, they make but short adventures from home, they flutter about in the noon-day heats, and soon after return chilled and feeble.

As their calamities increase, new passions soon begin to take place; the care for posterity no longer continues; and as the parents are by no means able to provide their growing progeny a supply, they take the barbarous resolution of sacrificing them all to the necessity of the times. In this manner, like a garrison upon short allowance, all the useless hands are destroyed; the young worms, which a little before they fed and protected with so much assiduity, are now butchered and dragged from their cells. As the cold increases they no longer find sufficient warmth in their nests, which become disagreeable to them, and they fly to seek it in the corners of houses, and places that receive an artificial heat. But the winter still continues insupportable; and, before the new year begins, they wither and die; the working wasps first, the males soon following, and many of the females suffer in the general calamity. In every nest, however, one or two females survive the winter, and having been impregnated by the male during the preceding season, she begins in spring to lay her eggs in a little hole of her own contrivance. This bundle of eggs which is clustered together like grapes, soon produces two worms, which the female takes proper precaution to defend and supply, and these, when hatched, soon give assistance to the female, who is employed in hatching two more; these also gathering strength, extricate themselves out of the web that inclosed them, and become likewise assistants to their mother; fifteen days after, two more make their appearance; thus is the community every day increasing, while the female lays in every cell, first a male and then a female. These soon after become breeders in turn, till, from a single female, ten thousand wasps are seen produced before the month of June. After the female has thus produced her progeny, which are distributed in different districts, they assemble from all parts in the middle of summer, and provide for themselves the large and commodious habitation, which has been described above.

Such is the history of the social wasp; but, as among bees, so also among these insects, there are various tribes that live in solitude; these lay their eggs in a hole contrived for the purpose, and the parent dies long before the birth of its offspring. In the principal species of the solitary wasps, the insect is smaller than the working wasp of the social kind. The filament by which the corselet is joined to the body, is longer and more distinctly seen, and the whole colour of the insect is blacker than in the ordinary kinds. It is, however, not their figure, but the manners of this extraordinary insect that claim our principal regard.

From the end of May to the beginning of July, this wasp is seen most diligently employed. The whole purpose of its life seems to be in contriving and fitting up a commodious apartment for its young one, which is not to succeed it till the year ensuing. For this end it is employed, with unwearied assiduity, in boring a hole into the finest earth some inches deep, but not much wider than the diameter of its own body. But this is only a gallery leading to a wider apartment which is destined for the convenient lodgement of its young. As it always chooses a gravelly soil to work in, and where the earth is almost as hard as stone itself, the digging and hollowing this apartment is an enterprise of no small labour: for effecting this operation, this insect is furnished with two teeth, which are strong and firm, but not sufficiently hard to penetrate the substance through which it is resolved to make its way. In order, therefore, to soften that earth which it is unable to pierce, it is furnished with a gummy liquor which it emits upon the place, and which renders it more easily separable from the rest, and the whole becoming a kind of soft paste is removed to the mouth of the habitation. But the animal's provision of liquor in these operations is soon exhausted; and it is then seen taking up water from some neighbouring flower or stream in order to supply the deficiency.

At length, after a great deal of toil, a hole some inches deep is formed, at the bottom of which is a large cavity; and to this no other hostile insect would venture to find its way, from the length and the narrowness of the defile through which it would be obliged to pass. In this the solitary wasp lays its egg, which is destined to continue the species; there the nascent animal is to continue for above nine months, unattended and immured, and, at first appearance, the most helpless insect of the creation. But when we come to examine, new wonders offer, and no other insect can boast so copiously luxurious a provision, or such confirmed security.

When the mother wasp has deposited her egg at the bottom of the hole, her next care is to furnish it with a supply of provisions, which may be offered to the young insect as soon as it leaves the egg. To this end she procures a number of little green worms, generally from eight to twelve, and these are to serve as food for the young one the instant it awakens into life. When this supply is regularly arranged and laid in, the old one then, with as much assiduity as it before worked out its hole, now closes the mouth of the passage; and thus leaving its young one immured in perfect security, and with a copious supply of animal food, she dies satisfied with having provided for a future race.

When the young one leaves the egg it is scarcely visible, and is seen immured among a number of insects, infinitely larger than itself, ranged in proper order around it, which, however, give it no manner of apprehension. Whether the parent, when she laid in the insect provision, contrived to disable the worms from resistance, or whether they were at first incapable of any, is not ascertained. Certain it is, that the young glutton feasts upon the living spoil without any control; his game lies at his hand, and he devours one after the other, as the calls of appetite incite him. The life of the young animal is therefore spent in the most luxurious manner, till its whole stock of worms is exhausted, and then the time of its transformation begins to approach; and after spinning a silken web, it continues fixed in its cell till the sun calls it from its dark abode the ensuing summer.

The wasps of Europe are exceedingly mischievous, yet they are innocence itself when compared to those of the tropical climates, where all the insect tribes are not only numerous, but large, voracious, and formidable. Those of the West Indies are thicker and twice as long as the common bee; they are of a grey colour, striped with yellow, and armed with a very dangerous sting. They make their cells in the manner of a honey-comb, in which the young ones are hatched and bred. They generally hang their nests by threads, composed of the same substance with the cells, to the branches of trees and the eaves of houses. They are seen every where in great abundance, descending like fruit, particularly pears, of which shape they are, and as large as one's head. The inside is divided into three round stories, full of cells, each hexagonal, like those of a honeycomb. In some of the islands these insects are so very numerous that their nests are stuck up in this manner, scarcely two feet asunder, and the inhabitants are in continual apprehension from their accidental resentment. It sometimes happens, that no precautions can prevent their attacks, and the pain occasioned by their sting is almost insupportable. Those who have felt it think it more terrible than that of a scorpion; the whole visage swells, and the features are so disfigured, that a person is scarcely known by his most intimate acquaintance.

OF THE ICHNEUMON FLY.

Every rank of insects, how voracious soever, have enemies that are terrible to them, and that revenge upon them the injuries done upon the rest of the Animated Creation. The wasp, as we have seen, is very troublesome to man, and very formidable to the insect tribe; but the ichneumon fly (of which there are many varieties) does not fear even the wasp itself; it enters its retreats, plunders its habitations, and takes possession of that cell for its own young, which the wasp had laboriously built for a dearer posterity.

Although there are many different kinds of this insect, yet the most formidable, and that best known, is called the common ichneumon, with four wings, like the bee, a long, slender, black body, and a three-forked tail, consisting of bristles; the two outermost black, and the middlemost red. This fly receives its name from the little quadruped which is found to be so destructive to the crocodile, as it bears a strong similitude in its courage and rapacity.

Though this instrument is to all appearance slender and feeble, yet it is observed to be a weapon of great force and efficacy. There is scarcely any substance which it will not pierce; and, indeed, it is seldom seen except employed in piercing something. This is the weapon of defence; this is used in destroying its prey; and still more, by this the animal deposits her eggs wherever she thinks fit to lay them. As it is an instrument chiefly employed for this purpose, the male is unprovided with such a sting, while the female uses it with great force and dexterity, brandishing it when caught, from side to side, and very often wounding those who thought they held her with the greatest security.

All the flies of this tribe are produced in the same manner, and owe their birth to the destruction of some other insect, within whose body they have been deposited, and upon whose vitals they have preyed till they came to maturity. There is no insect whatever which they will not attack in order to leave their fatal present in its body; the caterpillar, the gnat, and even the spider itself, so formidable to others, is often made the unwilling fosterer of this destructive progeny.

About the middle of summer, when other insects are found in great abundance, the ichneumon is seen flying busily about, and seeking proper objects upon whom to deposit its progeny. As there are various sorts of this fly, so they seem to have different appetites. Some are found to place their eggs within the aurelia of some nascent insect, others place them within the nest, which the wasp had curiously contrived for its own young: and as both are produced at the same time, the young of the ichneumon not only devours the young wasp, but the whole supply of worms, which the parent had carefully provided for its provision. But the greatest number of the ichneumon tribe are seen settling upon the back of the caterpillar, and darting, at different intervals, their stings into its body. At every dart they deposit an egg, while the wounded animal seems scarcely sensible of the injury it sustains. In this manner they leave from six to a dozen of their eggs within the fatty substance of the reptile's body, and then fly off to commit further depredations. In the mean time, the caterpillar, thus irreparably injured, seems to feed as voraciously as before; does not abate of its usual activity; and, to all appearance, seems no way affected by the internal enemies that are preparing its destruction in their darksome abode. But they soon burst from their egg state, and begin to prey upon the substance of their prison. As they grow larger, they require a greater supply; till at last the animal, by whose vitals they are supported, is no longer able to sustain them, but dies; its whole inside being almost eaten away. It often happens, however, that it survives their worm state, and then they change into a chrysalis, inclosed in the caterpillar's body till the time of their delivery approaches, when they burst their prisons and fly away. But the caterpillar is irreparably destroyed, it never changes into a chrysalis, but dies shortly after from the injuries it had sustained.

Such is the history of this fly, which, though very terrible to the insect tribe, fails not to be of infinite service to the human race. The millions which it kills in a single summer, are inconceivable; and without such a destroyer, the fruits of the earth would only rise to furnish a banquet for the insect race, to the exclusion of all the nobler ranks of Animated Nature.

OF THE ANT.

Although the number of two-winged flies be very great, and the different naturalists have taken some pains to describe their characters and varieties; yet there is such a similitude in their forms and manners, that in a work like this, one description must serve for all. We now, therefore, come to a species of four-winged insects, that are famous from all antiquity, for their social and industrious habits, that are marked for their spirit of subordination, that are offered as a pattern of parsimony to the profuse, and of unremitting diligence to the sluggard.

In the experiments, however, which have been more recently made, and the observations which have been taken, much of their boasted frugality and precaution seems denied them: the treasures they lay up are no longer supposed intended for future provision; and the choice they make in their stores, seems no way dictated by wisdom. It is, indeed, somewhat surprising, that almost every writer of antiquity should describe this insect, as labouring in the summer, and feasting upon the produce during the winter. Perhaps, in some of the warmer climates, where the winter is mild, and of short continuance, this may take place; but in France and England, these animals can have no manner of occasion for a supply of winter provisions, as they are actually in a state of torpidity during that season.

The common ants of Europe are of two or three different kinds; some red, some black, some with stings, and others without; such as have stings inflict wounds on those who disturb or offend them; such as are unprovided with these weapons of defence, have a power of spurting, from their hinder parts, an acid pungent liquor, which, if it lights upon the skin, inflames and burns it like nettles.

The body of an ant is divided into the head, breast, and belly. In the head the eyes are placed, which are entirely black, and under the eyes there are two small horns or feelers, composed of twelve joints, all covered with a fine silky hair. The mouth is furnished with two crooked jaws, which project outwards, in each of which are seen incisures, that look like teeth. The breast is also covered with a fine silky hair, from which project six legs, that are pretty strong and hairy, the extremities of each armed with two small claws, which the animal uses in climbing. The belly is more reddish than the rest of the body, which is of a brown chesnut colour, shining as glass, and covered with extremely fine hair.

From such a formation, this animal seems bolder and more active, for its size, than any other of the insect tribe, and fears not to attack a creature, often above ten times its own magnitude.

So soon as the winter is past, in the first fine day of April, the ant-hill, which before seemed a desert, now swarms with new life, and myriads of these insects are seen just awaked for their annual lethargy, and preparing for the pleasures and fatigues of the season. For the first day they never offer to leave the hill, which may be considered as their citadel, but run over every part of it, as if to examine its present situation, to observe what injuries it has sustained during the rigours of the season of winter, while they slept, and to meditate and settle the labours of the ensuing day.

At the first display of their forces, none but the wingless tribe appears, while those furnished with wings remain at the bottom. These are the working ants, that first appear, and that are always destitute of wings; the males and females, that are furnished with four large wings each, are more slow in making their appearance.

Thus, like bees, they are divided into males, females, and the neutral or the working tribe. These are all easily distinguished from each other; the females are much larger than the males; the working ants are the smallest of all. The two former have wings; which, however, they sometimes are divested of; the latter never have any, and upon them are devolved all the labours that tend to the welfare of the community. The female also may be distinguished by the colour and structure of her breast, which is a little more brown than that of the common ant, and a little brighter than that of the male.

In eight or ten days after their first appearance, the labours of the hill are in some degree of forwardness; the males and females are seen mixed with the working multitude, and pursued or pursuing each other. Indeed, they seem no way to partake in the common drudgeries of the state; the males pursue the females with great assiduity, and in a manner force them to obedience. They remain for some time, while the males suffer themselves to be drawn along by the will of their partners.

In the mean time, the working body of the state take no part in their pleasures; they are seen diligently going from the ant-hill, in pursuit of food for themselves and their associates, and of proper materials for giving a comfortable retreat to their young, or safety to their habitation. In the fields of England, ant-hills are formed with but little apparent regularity. In the more southern provinces of Europe, they are constructed with wonderful contrivance, and offer a sight highly worthy a naturalist's curiosity. These are generally formed in the neighbourhood of some large tree and a stream of water. The one is considered by the animals as the proper place for getting food; the other for supplying them with moisture, which they cannot well do without. The shape of the ant-hill, is that of a sugar loaf, about three feet high, composed of various substances; leaves, bits of wood, sand, earth, bits of gum, and grains of corn. These are all united into a compact body, perforated with galleries down to the bottom, and winding ways within the body of the structure. From this retreat, to the water, as well as to the tree, in different directions, there are many paths worn by constant assiduity and along these the busy insects are seen passing and repassing continually; so that from May, to the beginning of June, according to the state of the season, they work continually, till the bad weather comes on.

The chief employment of the working ants, is in sustaining not only the idlers at home, but also in finding a sufficiency of food for themselves. They live upon various provisions, as well of the vegetable as the animal kind. Small insects they will kill and devour; sweets, of all kinds, they are particularly fond of: but they seldom think of their community, till they themselves are first satiated. Having found a juicy fruit, they swallow what they can, and then tearing it in pieces, carry home their load. If they meet with an insect above their match, several of them will fall upon it at once, and having mangled it, each will become the bearer of a part of the spoil. If they meet, in their excursions, any thing that is too heavy for one to bear, and yet, which they are unable to divide, several of them will endeavour to force it along; some dragging and others pushing. If any one of them should happen to make a lucky discovery, it will immediately give advice to others, and then, at once, the whole republic will put themselves in motion. If in these struggles, one of them happens to be killed, some kind survivor will carry him off to a great distance, to prevent the obstructions his body might give to the general spirit of industry.

But while they are thus employed in supporting the state, in feeding abroad, and carrying in provisions to those that continue at home, they are not unmindful of posterity. After a few days of fine weather, the female ants begin to lay their eggs, and those are as assiduously watched and protected by the working ants, who take upon themselves to supply whatever is wanting to the nascent animal's convenience or necessity. They are carried, as soon as laid, to the safest situation, at the bottom of their hill, where they are carefully defended from cold and moisture. We are not to suppose, that those white substances which we so plentifully find in every ant-hill, are the eggs as newly laid. On the contrary, the ant's egg is so very small, that, though laid upon a black ground, it can scarcely be discerned. The little white bodies we see, are the young animals in their maggot state, endued with life, long since freed from the egg, and often involved in a cone, which it has spun round itself, like the silk worm. The real egg, when laid, if viewed through a microscope, appears smooth, polished, and shining, while the maggot is seen composed of twelve rings, and is often larger than the ant itself.

It is impossible, in fact, to express the fond attachment which the working ants show to their rising progeny. In cold weather they take them in their mouths, but without offering them the smallest injury, to the very depths of their habitation, where they are less subject to the severity of the season. In a fine day they remove them, with the same assiduity and care, nearer the surface, where their maturity may be assisted by the warm beams of the sun. If a formidable enemy should advance to batter down their whole habitation, and crush them by thousands in the ruin, yet these wonderful insects, still mindful of their parental duties, make it their first care to save their offspring. They are seen running wildly about, and different ways, each loaded with a young one, often bigger than the insect that supports it. I have kept, says Swammerdam, several of the working ants in my closet, with their young, in a glass filled with earth. I took pleasure in observing, that in proportion as the earth dried on the surface, they dug deeper and deeper to deposit their eggs; and when I poured water thereon, it was surprising to see with what care, affection, and diligence they laboured, to put their brood in safety, in the driest place. I have likewise seen, that when water has been wanting for several days, and when the earth was moistened after it a little, they immediately carried their young ones to have a share, who seemed to enjoy and suck the moisture.

When the young maggot is arrived at its full growth, the breast swells insensibly, it casts its skin, and loses all motion. All the members which were hidden before, then begin to make their appearance; an aurelia is formed, which represents very distinctly all the parts of the animal, though they are yet without motion, and, as it were, wrapped up in swaddling-clothes. When at length, the little insect has passed through all its changes, and acquired its proper maturity, it bursts this last skin, to assume the form it is to retain ever after. Yet this is not done by the efforts of the little animal alone, for the old ones very assiduously break open with their teeth the covering in which it is inclosed. Without this assistance the aurelia would never be able to get free, as M. de Geer often found, who tried the experiment by leaving the aurelia to themselves. The old ones not only assist them, but know the very precise time for lending their assistance: for if produced too soon, the young one dies of cold; if retarded too long, it is suffocated in its prison.

When the female has done laying, and the whole brood is thus produced, her labours, as well as that of the male, become unnecessary, and her wings, which she had but a short time before so actively employed, drop off. What becomes of her when thus divested of her ornaments is not well known, for she is seen in the cells for some weeks after. The males, on the other hand, having no longer any occupation at home, make use of those wings with which they have been furnished by nature, and fly away, never to return, or to be heard of more. It is probable they perish with the cold, or are devoured by the birds, which are particularly fond of this petty prey.

In the meantime, the working ants, having probably deposed their queens, and being deserted by the males, that serve but to clog the community, prepare for the severity of the winter, and bury their retreats as deep in the earth as they conveniently can. It is now discovered that the grains of corn, and other substances with which they furnish their hill, are only meant as fences to keep off the rigours of the weather, not as provisions to support them during its continuance. It is found generally to obtain, that every insect lives a year after arriving at its full growth, and is obliged to pass four or five months without taking any nourishment, seeming to be dead all that time. It would be to no purpose, therefore, for ants to lay up corn for winter, since they lie during that season without motion, heaped upon each other, and are so far from eating, that they are utterly unable to stir. Thus what some authors have dignified by the name of a magazine, appears to be no more than a cavity, which serves for a common retreat when the weather forces them to return to their lethargic state.

What has been said with exaggeration of the European ant is however true, if asserted of those of the tropical climates. They build an ant-hill with great contrivance and regularity, they lay up provisions, and, as they probably live the whole year, they submit themselves to regulations entirely unknown among the ants of Europe.

Those of Africa are of three kinds, the red, the green, and the black; the latter are above an inch long, and in every respect a most formidable insect. Their sting produces extreme pain, and their depredations are sometimes exceedingly destructive. They build an ant-hill of a very great size, from six to twelve feet high; it is made of viscous clay, and tapers into a pyramidal form. This habitation is constructed with a great deal of artifice; and the cells are so numerous and even, that a honeycomb scarcely exceeds them in number and regularity.

The inhabitants of this edifice seem to be under a very strict regulation. At the slightest warning they will sally out upon whatever disturbs them, and if they have time to arrest their enemy, he is sure to find no mercy. Sheep, hens, and even rats, are often destroyed by these merciless insects, and their flesh devoured to the bone. No anatomist in the world can strip a skeleton so cleanly as they; and no animal, how strong soever, when they have once seized upon it, has power to resist them.

It frequently happens, that these insects quit their retreat in a body, and go in quest of adventures. 'During my stay,' says Smith, at 'Cape Corse Castle, a body of these ants came to pay us a visit in our fortification. It was about day-break when the advanced guard of this famished crew entered the chapel, where some Negro servants were asleep upon the floor. The men were quickly alarmed at the invasion of this unexpected army, and prepared, as well as they could, for a defence. While the foremost battalion of insects had already taken possession of the place, the rear-guard was more than a quarter of a mile distant. The whole ground seemed alive, and crawling with unceasing destruction. After deliberating a few moments upon what was to be done, it was resolved to lay a large train of gunpowder along the path they had taken; by this means millions were blown to pieces, and the rear-guard, perceiving the destruction of their leaders, thought proper instantly to return, and make back to their original habitation.'

The order which these ants observe seems very extraordinary; whenever they sally forth, fifty or sixty larger than the rest are observed to head the band, and conduct them to their destined prey. If they have a fixed spot where their prey continues to resort, they then form a vaulted gallery, which is sometimes a quarter of a mile in length; and yet they will hollow it out in the space of ten or twelve hours.

OF THE BEETLE AND ITS VARIETIES.

Hitherto we have been treating of insects with four transparent wings, we now come to a tribe with only two transparent wings, and with cases that cover them close while at rest, but which allow them their proper play when flying. The principal of these are the beetle, the may-bug, and the cantharis. These are all bred like the rest of their order, first from eggs, then they become grubs, then a chrysalis, in which the parts of the future fly are distinctly perceivable; and, lastly, the animal leaves its prison, breaking forth as a winged animal in full maturity.

Of the beetle there are various kinds; all, however, concurring in one common formation of having cases to their wings, which are the more necessary to those insects, as they often live under the surface of the earth, in holes which they dig out by their own industry. These cases prevent the various injuries their real wings might sustain, by rubbing or crushing against the sides of their abode. These, though they do not assist flight, yet keep the internal wings clean and even, and produce a loud buzzing noise when the animal rises in the air.

If we examine the formation of all animals of the beetle kind, we shall find, as in shell-fish, that their bones are placed externally, and their muscles within. These muscles are formed very much like those of quadrupeds, and are endued with such surprising strength, that, bulk for bulk, they are a thousand times stronger than those of a man. The strength of these muscles is of use in digging the animal's subterraneous abode, where it is most usually hatched, and to which it most frequently returns, even after it becomes a winged insect, capable of flying.

Beside the difference which results from the shape and colour of these animals, the size also makes a considerable one; some beetles being not larger than the head of a pin, while others, such as the elephant beetle, are as big as one's fist: But the greatest difference among them is, that some are produced in a month, and in a single season go through all the stages of their existence; while others take near four years to their production, and live as winged insects a year more. To give the history of all these animals, that are bred pretty nearly in the same way, would be insipid and endless; it must therefore suffice to select one or two from the number, the origin of which may serve as specimens of the rest. We shall, therefore, offer the history of the may-bug to the reader's attention; premising that most other beetles, though not so long-lived, are bred in the same manner.

The may-bug, or dorr-beetle, as some call it, has, like all the rest, a pair of cases to its wings, which are of a reddish brown colour, sprinkled with a whitish dust, which easily comes off. In some years their necks are seen covered with a red plate, and in others, with a black one; these, however, are distinct sorts, and their difference is by no means accidental. The fore-legs are very short, and the better calculated for burrowing in the ground, where this insect makes its retreat. It is well known for its evening buzz, to children; but still more formidably introduced to the acquaintance of husbandmen and gardeners; for, in some seasons, it has been found to swarm in such numbers, as to eat up every vegetable production.

The two sexes in the may-bug are easily distinguished from each other, by the superior length of the tufts, at the end of the horns, in the male. They begin to unite in summer, and, at that season, the female falls to boring a hole in the ground, where to deposit her burden. This is generally about half a foot deep, and in it she places her eggs, which are of an oblong shape, with great regularity, one by the other. They are of a bright yellow colour, and by no means wrapped up in a common covering, as some have imagined. When the female is lightened of her burden, she again ascends from her hole, to live as before, upon leaves and vegetables, to buzz in the summer evening, and to lie hid among the branches of trees, during the heat of the day.

In about three months after these eggs have been thus deposited in the earth, the contained insect begins to break its shell, and a small grub or maggot crawls forth, and feeds upon the roots of whatever vegetable it happens to be nearest.

All substances of this kind seem equally grateful, yet it is probable the mother insect has a choice among what kind of vegetables she shall deposit her young. In this manner these voracious creatures continue in the worm state, for more than three years, devouring the roots of every plant they approach, and making their way under ground, in quest of food, with great dispatch and facility. At length they grow to above the size of a walnut, being a great thick white maggot with a red head, which is perceived most frequently in new-turned earth, and which is so eagerly sought after by birds of every species. When largest, they are found an inch and a half long, of a whitish yellow colour, with a body consisting of twelve segments or joints, on each side of which there are nine breathing-holes, and three red feet. The head is large in proportion to the body, of a reddish colour, with a pincer before, and a semi-circular lip, with which it cuts the roots of plants, and sucks out their moisture. As this insect lives entirely under ground, it has no occasion for eyes, and accordingly it is found to have none: but it is furnished with two feelers, which, like the crutch of a blind man, serves to direct its motions. Such is the form of this animal, that lives for years in the worm state under ground, still voracious, and every year changing its skin.

It is not, however, till the end of the fourth year, that this extraordinary insect prepares to emerge from its subterraneous abode, and even this is not effected, but by a tedious preparation. About the latter end of autumn, the grub begins to perceive the approach of its transformation; it then buries itself deeper and deeper in the earth, sometimes six feet beneath the surface, and there forms itself a capacious apartment, the walls of which it renders very smooth and shining, by the excretions of its body. Its abode being thus formed, it begins, soon after, to shorten itself, to swell, and to burst its last skin, in order to assume the form of a chrysalis. This, in the beginning, appears of a yellowish colour, which heightens by degrees, till at last it is seen nearly red. Its exterior form plainly discovers all the vestiges of the future winged insect, all the fore-parts being distinctly seen;

while behind, the animal seems as if wrapped in swaddling clothes.

The young may-bug continues in this state for about three months longer; and it is not till the beginning of January, that the aurelia divests itself of all its impediments, and becomes a winged insect, completely formed. Yet still the animal is far from attaining its natural strength, health, and appetite. It undergoes a kind of infant imbecility, and unlike most other insects, that the instant they become flies are arrived at their state of full perfection, the may-bug continues feeble and sickly. Its colour is much brighter than in the perfect animal, all its parts are soft, and its voracious nature seems for a while, to have entirely forsaken it. As the animal is very frequently found in this state, it is supposed, by those unacquainted with its real history, that the old ones, of the former season, have buried themselves for the winter, in order to revisit the sun the ensuing summer. But the fact is, the old one never survives the season, but dies, like all the other winged tribe of insects, from the severity of cold in the winter.

About the latter end of May, these insects, after having lived for four years under ground, burst from the earth, when the first mild evening invites them abroad. They are at that time seen rising from their long imprisonment, from living only upon roots, and imbibing only the moisture of the earth, to visit the mildness of the summer air, to choose the sweetest vegetables for their banquet, and to drink the dew of the evening. Wherever an attentive observer then walks abroad, he will see them bursting up before him in his pathway, like ghosts on a theatre. He will see every part of the earth, that had its surface beaten into hardness, perforated by their egression. When the season is favourable for them, they are observed by myriads buzzing along, and hitting against every object that intercepts their flight. The mid-day sun, however, seems too powerful for their constitutions; they then lurk under the leaves and branches of some shady tree; but the willow seems particularly their most favourite food; there they lurk in clusters, and seldom quit the tree till they have devoured all its verdure. In those seasons, which are favourable to their propagation, they are seen in an evening as thick as flakes of snow, and hitting against every object with a sort of capricious blindness. But their duration is only for a short time, since they never survive the season. They begin to join shortly after they have been let loose from their prison, and the female cautiously bores a hole in the ground, with an instrument fitted for that purpose, which she is furnished with at the tail, and there deposits her eggs, generally to the number of threescore. If the season and the soil be adapted to their propagation, these soon multiply as already described, and go through the noxious stages of their contemptible existence. This insect, however, in its worm state, though prejudicial to man, makes one of the chief repasts of the feathered tribe, and is generally the first nourishment with which they supply their young. Rooks and hogs are particularly fond of these worms, and devour them in great numbers. The inhabitants of the county of Norfolk, some time since, went into the practice of destroying their rookeries, but in proportion as they destroyed one plague, they were pestered with a greater; and these insects multiplied in such an amazing abundance, as to destroy not only the verdure of the fields, but even the roots of vegetables not yet shot forth. One farm in particular was so injured by them in the year 1751, that the occupier was not able to pay his rent, and the landlord was not only content to lose his income for that year, but also gave money for the support of the farmer and his family. In Ireland they suffered so much by these insects, that they came to a resolution of setting fire to a wood, of some miles in extent, to prevent their mischievous propagation.

Of all the beetle kind this is the most numerous, and therefore deserves particular attention. The numerous varieties of other kinds might repay the curiosity of the diligent observer, but we must be content in general to observe, that in the great outlines of their history, they resemble those of which we have just been giving a description; like them, all other beetles are bred from the egg, which is deposited in the ground, or sometimes, though seldom, in the barks of trees, they change into a worm; they subsist in that state by living upon the roots of vegetables, or the succulent parts of the bark round them. They generally live a year at least before they change into an aurelia; in that state they are not entirely motionless, nor entirely swaddled up without form.

It would be tedious and endless to give a description of all, and yet it would be an unpardonable omission not to mention the particularities of some beetles, which are singular rather from their size, their manners, or their formation. That beetle, which the Americans call the tumble-dung, principally demands our attention; it is all over of a dusky black, rounder than those animals are generally found to be, and so strong, though not much larger than the common black beetle, that if one of them be put under a brass candlestick, it will cause it to move backwards and forwards, as if it were by an invisible hand, to the admiration of those who are not accustomed to the sight; but this strength is given it for much more useful purposes than those of exciting human curiosity, for there is no creature more laborious, either in seeking for its subsistence, or in providing a proper retreat for its young. They are endowed with sagacity to discover subsistence by their excellent smelling, which directs them in flights to excrements just fallen from man or beast, on which they instantly drop, and fall unanimously to work in forming round balls or pellets thereof, in the middle of which they lay an egg. These pellets, in September, they convey three feet deep in the earth, where they lie till the approach of spring; when the eggs are hatched the nests burst, and the insects find their way out of the earth. They assist each other with indefatigable industry in rolling these globular pellets to the place where they are to be buried. This they are to perform with the tail foremost, by raising up their hinder part, and shoving the ball along with their hind-feet. They are always accompanied by other beetles of a larger size, and of a more elegant structure and colour. The breast of this is covered with a shield of crimson colour, and shining like metal; the head is of similar colour, mixed with green, and on the crown of the head stands a shining black horn, bended backwards. These are called the kings of the beetles, but for what reason is uncertain, since they partake of the same dirty drudgery with the rest.

The elephant-beetle is the largest of this kind hitherto known, and is found in South America, particularly Guiana and Surinam, as well as about the river Oroonoko. It is of a black colour, and the whole body is covered with a very hard shell, full as thick and as strong as that of a small crab. Its length, from the hinder part to the eyes, is almost four inches, and from the same part to the end of the proboscis, or trunk, four inches and three quarters. The transverse diameter of the body is two inches and a quarter, and the breadth of each elytron, or case for the wings, is an inch and three-tenths. The antennæ, or feelers, are quite horny; for which reason the proboscis, or trunk, is moveable at its insertion into the head, and seems to supply the place of feelers. The horns are eight-tenths of an inch long, and terminate in points. The proboscis is an inch and a quarter long, and turns upwards, making a crooked line, terminating in two horns, each of which is nearly a quarter of an inch long, but they are not perforated at the end like the proboscis of other insects. Above four-tenths of an inch above the head, on that side next the body, is a prominence or small horn, which if the rest of the trunk were away, would cause this part to resemble the horn of a rhinoceros. There is indeed a beetle so called, but then the horns or trunk has no fork at the end, though the lower horn resembles this. The feet are all forked at the end, but not like lobsters' claws.

To this class we may also refer the glow-worm, that little animal which makes such a distinguished figure in the descriptions of many of our poets. No two insects can differ more than the male and female of this species from each other. The male is in every respect a beetle, having cases to its wings, and rising in the air at pleasure; the female, on the contrary, has none, but is entirely a creeping insect, and is obliged to wait the approaches of her capricious companion. The body of the female has eleven joints, with a shield breast-plate, the shape of which is oval; the head is placed over this, and is very small, and the three last joints of her body are of a yellowish colour; but what distinguishes it from all other animals, at least in this part of the world, is the shining light which it emits by night, and which is supposed by some philosophers to be an emanation which she sends forth to allure the male to her company. Most travellers who have gone through sandy countries must well remember the little, shining sparks with which the ditches are studded on each side of the road. If incited by curiosity to approach more nearly he will find this light sent forth by the glow-worm; if he should keep the little animal for some time, its light continues to grow paler, and at last appears totally extinct. The manner in which the light is produced has hitherto continued inexplicable; it is probable the little animal is supplied with some electrical powers, so that by rubbing the joints of its body against each other, it thus supplies a stream of light, which if it allures the male, as we are told, serves for very useful purposes.

The cantharis is of the beetle kind, from whence come cantharides, well known in the shops by the name of Spanish flies, and for their use in blisters. They have feelers like bristles, flexible cases to the wings, a breast pretty plain, and the sides of the belly wrinkled. Cantharides differ from each other in their size, shape, and colour; those used in the shops also do the same. The largest in these parts are about an inch long, and as much in circumference, but others are not above three quarters of an inch. Some are of a pure azure colour, others of pure gold, and others again, have a mixture of pure gold and azure colours; but they are all very brilliant, and extremely beautiful. These insects, as is well known, are of the greatest benefit to mankind, making a part in many medicines conducive to human preservation. They are chiefly natives of Spain, Italy, and Portugal; but they are to be met with also about Paris in the summer time, upon the leaves of the ash, the poplar, and the rose-trees, and also among wheat, and even in meadows. It is very certain that these insects are fond of ash-leaves, insomuch that they will sometimes strip one of these trees quite bare. Some affirm, that these flies delight in sweet-smelling herbs; and it is likewise certain, that they are fond of honey-suckles, lilach, and wild-cherry shrubs; but some that have sought after them declare, they never could find them on elder-trees, nut-trees, and among wheat. We are told that the country people expect the return of these insects every seven years. And it is also evident that such a number of these insects have been seen together in the air, that they appeared like swarms of bees; and that they have so disagreeable a smell, that it may be perceived a great way off, especially about sunset, though they are not seen at that time. This bad smell is a guide for those who make it their business to catch them. When they are caught they dry them, after which they are so light, that fifty will hardly weigh a dram. Those that gather them, tie them in a bag, or a piece of linen cloth, that has been well worn, and then they kill them with the vapours of hot vinegar, after which they dry them in the sun, and keep them in boxes. These flies, thus dried, being chymically annalyzed, yield a great deal of volatile, caustic salt, mixed with a little oil, phlegm, and earth. Cantharides are penetrating, corrosive, and, applied to the skin, raise blisters, from whence proceeds a great deal of serosity. They are made use of both inwardly and outwardly. However, it is somewhat strange that the effects of these flies should fall principally upon the urinary passages, for though some authors have endeavoured to account for this, we are still in the dark, for all they have said amounts to no more, than that they affect these parts in a manner which may be very learnedly described, but very obscurely comprehended.

An insect of great, though perhaps not equal use in medicine, is that which is known by the name of the Kermes; it is produced in the excrescence of an oak, called the berry-bearing ilex, and appears at first wrapt up in a membranous bladder, of the size of a pea, smooth and shining, of a brownish red colour, and covered with very fine ash-coloured powder. This bag teems with a number of reddish eggs or insects, which being rubbed with the fingers pour out a crimson liquor. It is only met with in warm countries in the months of May and June. In the month of April this insect becomes of the size and shape of a pea, and its eggs some time after burst from the womb, and soon turning worms, run about the branches and leaves of the tree. They are of two sexes, and the females have been hitherto described; but the males are very distinct from the former, and are a sort of small flies like gnats, with six feet, of which the four forward are short, and the two hinder ones long, divided into four joints, and armed with three crooked nails. There are two feelers on the head, a line and a half long, which are moveable, streaked, and articulated. The tail, at the back part of the body, is half a line long and forked. The whole body is covered with two transparent wings, and they leap about in the manner of fleas. The harvest of the kermes is greater or less in proportion to the severity of the winter, and the women gather them before sun-rising, tearing them off with their nails; for fear there should be any loss from the hatching of the insects. They sprinkle them with vinegar, and lay them in the sun to dry, where they acquire a red colour.

An insect, perhaps, still more useful than either of the former, is the Cochineal, which has been very variously described by different authors; some have supposed it a vegetable excrescence from the tree upon which it is found; some have described it as a louse, some as a bug, and others as a beetle. As they appear in our shops when brought from America, they are o an irregular shape, convex on one side, and a little concave on the other; but they are both marked with transverse streaks or wrinkles. They are of a scarlet colour within, and without of a blackish red, and sometimes of a white, reddish, or ash-colour, which are accounted the best, and are brought to us from Mexico. The cochineal insect is of an oval form, of the size of a small pea, with six feet, and a snout or trunk. It brings forth its young alive, and is nourished by sucking the juice of the plant. Its body consists of several rings, and when it is once fixed on the plant, it continues immoveable, being subject to no change. Some pretend there are two sorts, the one domestic, which is best, and the other wild, that is of a vivid colour; but they appear to be the same, only with this difference, that the wild feeds upon uncultivated trees, without any assistance, whereas the domestic is carefully, at a stated season, removed to cultivated trees, where it feeds upon a purer juice. Those who take care of these insects, place them on the prickly pear-plant in a certain order, and are very industrious in defending them from other insects; for if any other kind come among them, they take care to brush them off with foxes' tails. Towards the end of the year, when the rains and cold weather are expected, which are fatal to these insects, they take off the leaves or branches covered with cochineal, that have not attained their utmost degree of perfection, and keep them in their houses till winter is past. These leaves are very thick and juicy, and supply them with sufficient nourishment, while they remain within doors. When the milder weather returns, and these animals are about to exclude their young, the natives make them nests, like those of birds, but less, of tree moss, or soft hay, or the down of cocoa-nuts, placing twelve in every nest. These they fix on the thorns of the prickly pear-plant, and in the space of three or four days they bring forth their young, which leave their nest in a few days, and creep upon the branches of the plant, till they find a proper place to rest in, and take in their nourishment; and until the females are fecundated by the males, which, as in the former tribe, differ very widely from the females, being winged insects, whereas the others only creep, and are at most stationary. When impregnated, they produce a new offspring, so that the propagator has a new harvest thrice a-year. When the native Americans have gathered the cochineal, they put them into holes in the ground, where they kill them with boiling water, and afterwards dry them in the sun, or in an oven, or lay them upon hot plates. From the various methods of killing them, arise the different colours which they appear in when brought to this country. While they are living, they seem to be sprinkled ove with a white powder, which they lose as soon as th boiling water is poured upon them. Those that a dried upon hot plates are the blackest. What we call the cochineal are only the females, for the males are a sort of fly, as already observed in the kermes. They are used both for dyeing and medicine, and are said to have much the same virtue as the kermes, though they are now seldom used alone, but are mixed with other things for the sake of the colour.

We shall close this account of the beetle tribe with the history of an animal which cannot properly be ranked under this species, and yet which cannot be more methodically ranged under any other. This is the insect that forms and resides in the gall-nut, the spoils of which are converted to such useful purposes. The gall-insects are bred in a sort of bodies adhering to a kind of oak in Asia, which differ with regard to their colour, size, roughness, smoothness, and shape, and which we call galls. They are not fruit, as some have imagined, but preternatural tumours, owing to the wounds given to the buds, leaves, and twigs of the tree, by a kind of insects that lay their eggs within them. This animal is furnished with an implement by which the female penetrates into the bark of the tree, or into that spot which just begins to bud, and there sheds a drop of corrosive fluid into the cavity. Having thus formed a receptacle for her eggs, she deposits them in the place, and dies soon after. The heart of the bud being thus wounded, the circulation of the nutritive juice is interrupted, and the fermentation thereof, with the poison injected by the fly, burns the parts adjacent, and then alters the natural colour of the plant. The juice or sap, turned back from its natural course, extravasates and flows round the egg. After which it swells and dilates by the assistance of some bubbles of air, which obtain admission through the pores of the bark, and which run in the vessels with the sap. The external coat of this excrescence is dried by the air, and grows into a figure which bears some resemblance to the bow of an arch, or the roundness of a kernel. This little ball receives its nutriment, growth, and vegetation as the other parts of the tree, by slow degrees, and is what we call the *gall-nut*. The worm that is hatched under this spacious vault finds in the substance of the gall, which is as yet very tender, a subsistence suitable to its nature; gnaws and digests it till the time comes for its transformation to a nymph, and from that state of existence changes into a fly. After this, the insect, perceiving itself duly provided with all things requisite, disengages itself in a short time from its confinement, and takes its flight into the open air. The case, however, is not similar with respect to the gall nut that grows in autumn. The cold weather frequently comes on before the worm is transformed into a fly, or before the fly can pierce through its inclosure. The nut falls with the leaves, and although it may be imagined that the fly which lies within is lost, yet in reality it is not so; on the contrary, its being covered up so close is the means of its preservation. Thus it spends the winter in a warm house, where every crack and cranny of the nut is well stopped up; and lies buried, as it were, under a heap of leaves, which preserves it from the injuries of the weather. This apartment, however, though so commodious a retreat in the winter, is a perfect prison in the spring. The fly, roused out of its lethargy by the first heats, breaks its way through, and ranges where it pleases. A very small aperture is sufficient, since at this time the fly is but a diminutive creature. Besides, the ringlets whereof its body is composed, dilate, and become pliant in the passage.

OF THE GNAT AND TIPULA.

There are two insects which entirely resemble each other in their form, and yet widely differ in their habits, manners, and propagation. Those who have seen the tipula, or long-legs, and the larger kind of gnat, have most probably mistaken the one for the other; they have often accused the tipula, a harmless insect, of depredations made by the gnat, and the innocent have suffered for the guilty; indeed the differences in their form are so very minute, that it often requires the assistance of a microscope to distinguish the one from the other: they are both mounted on long legs, both furnished with two wings and a slender body; their heads are large, and they seem to be hump-backed; the chief and only difference, therefore, is, that the tipula wants a trunk, while the gnat has a large one, which it often exerts to very mischievous purposes. The tipula is a harmless, peaceful insect, that offers injury to nothing; the gnat is sanguinary and predaceous, constantly seeking out for a place in which to bury its trunk, and pumping up the blood from the animal in large quantities.

The gnat proceeds from a little worm, which is usually seen at the bottom of stagnant waters. The manner in which the insect lays its eggs is particularly curious; after having laid the proper number on the surface of the water, it surrounds them with a kind of unctuous matter, which prevents them from sinking, but at the same time fastens them with a thread to the bottom, to prevent their floating away, at the mercy of every breeze, from a place, the warmth of which is proper for their production, to any other, where the water may be too cold, or the animals, its enemies, too numerous. Thus the insects, in their egg state, resemble a buoy, which is fixed by an anchor. As they come to maturity they sink deeper; and at last, when they leave the egg as worms, they creep at the bottom. They now make themselves lodgements of cement, which they fasten to some solid body at the very bottom of the water, unless, by accident, they meet with a piece of chalk, which, being of a soft and pliant nature, affords them an opportunity of sinking a retreat for themselves, where nothing but the claws of a cray-fish can possibly molest them. The worm afterwards changes its form. It appears with a large head, and a tail invested with hair, and moistened with an oleaginous liquor, which she makes use of as a cork, to sustain her head in the air, and her tail in the water, and to transport her from one place to another. When the oil with which her tail is moistened begins to grow dry, she discharges out of her mouth an unctuous humour, which she sheds all over her tail, by virtue whereof she is enabled to transport herself where she pleases, without being either wet or in any manner incommoded by the water. The gnat, in her second state, is, properly speaking, in the form of a nymph, which is an introduction, or entrance into new life. In the first place she divests herself of her second skin; in the next she resigns her eyes, her antennæ, and her tail; in short, she actually seems to expire. But from the spoils of the amphibious animal, a little winged insect cuts the air, whose every part is active to the last degree, and whose whole structure is the just object of our admiration. Its little head is adorned with a plume of feathers, and its whole body invested with scales and hair, to secure it from any wet or dust. She makes trial of the activity of her wings by rubbing them either against her body, or her broad side bags, which keep her in equilibrio. The furbelow, or little border of fine feathers, which graces her wings, is very curious, and strikes the eye in the most agreeable manner. There is nothing, however, of greater importance to the gnat than her trunk, and that weak implement may justly be deemed one of Nature's master-pieces. It is so very small, that the extremity of it can scarcely be discerned through the best microscope that can be procured. That part which is at first obvious to the eye, is nothing but a long scaly sheath under the throat. At nearly the distance of two-thirds of it, there is an aperture, through which the insect darts out four stings, and afterwards retracts them. One of which, however sharp and active it may be, is no more than the case in which the other three lie concealed, and run in a long groove. The sides of these stings are sharpened like two-edged swords; they are likewise barbed, and have a vast number of cutting teeth towards the point, which turns up like a hook, and is fine beyond expression. When all these darts are stuck into the flesh of animals, sometimes one after another, and sometimes all at once, the blood and humours of the adjacent parts must unavoidably be extravasated; upon which a tumour must consequently ensue, the little orifice whereof is closed up by the compression of the external air. When the gnat, by the point of her case, which she makes use of as a tongue, has tasted any fruit, flesh, or juice, that she has discovered, if it be a fluid, she sucks it up, without playing her darts into it; but in case she finds the least obstruction by any flesh whatever, she exerts her strength and pierces through it, if possibly she can. After this she draws back her stings into their sheath, which she applies to the wound in order to extract, as through a reed, the juices which she finds inclosed. This is the implement with which the gnat performs her work in the summer, for during the winter she has no manner of occasion for it. Then she ceases to eat, and spends all that tedious season either in quarries, or in caverns, which she abandons at the return of summer, and flies about in search of some commodious ford, or standing water, where she may produce her progeny, which would be quickly washed away and lost, by the too rapid motion of any running stream. The little brood are sometimes so numerous, that the very water is tinged according to the colour of the species, as green, if they be green, and of a sanguine hue, if they be red.

These are circumstances sufficiently extraordinary in the life of this little animal, but it offers something still more curious in the method of its propagation. However similar insects of the gnat kind are in their appearance, yet they differ widely from each other in the manner in which they are brought forth, for some are oviparous, and are produced from eggs; some are viviparous, and come forth in their most perfect form; some are males, and unite with the females; some are females, requiring the impregnation of the male; some are of neither sex, yet still produce young, without any intercourse whatsoever. This is one of the strangest discoveries in all Natural History! A gnat separated from the rest of its kind, and inclosed in a glass vessel, with air sufficient to keep it alive, shall produce young, which also, when separated from each other, shall be the parents of a numerous progeny. Thus, down for five or six generations do these extraordinary animals propagate without any congress between the male and the female, but in the manner of vegetables. At the sixth generation, however, their propagation stops; the gnat no longer produces its like, from itself alone, but it requires the access of the male to give it another succession of fecundity.

The gnat of Europe gives but little uneasiness; it is sometimes heard to hum about our beds at night, and keeps off the approach of sleep by the apprehension it causes; but it is very different in the ill-peopled regions of America, where the waters stagnate, and the climate is warm, and where they are produced in multitudes beyond conception. The whole air is there filled with clouds of those famished insects, and they are found of all sizes, from six inches long to a minuteness that even requires the microscope to have a distinct pereeption of them. The warmth of the mid-day sun is too powerful for their constitutions; but when the evening approaches, neither art nor flight can shield the wretched inhabitants from their attacks; though millions are destroyed, still millions more succeed, and produce unceasing torment. The native Indians, who anoint their bodies with oil, and who have from their infancy been used to their depredations, find them much less inconvenient than those who are newly arrived from Europe; they sleep in their cottages covered all over with thousands of the gnat kind upon their bodies, and yet do not seem to have their slumbers interrupted by their cruel devourers. If a candle happens to be lighted in one of those places, a cloud of insects at once light upon the flame, and extinguish it; they are therefore obliged to keep their candles in glass lanterns; a miserable expedient to prevent an unceasing calamity.

OF THE ZOOPHYTES.

OF ZOOPHYTES IN GENERAL.

We now come to the last link in the chain of Animated Nature, to a class of beings so confined in their powers, and so defective in their formation, that some historians have been at a loss whether to consider them as a superior rank of vegetables, or the humblest order of the animated tribe. In order, therefore, to give them a denomination agreeable to their existence, they have been called Zoophytes, a name implying vegetable nature endued with animal life; and, indeed, in some the marks of the animal are so few, that it is difficult to give their place in Nature with precision, or to tell whether it is a plant or an insect that is the object of our consideration.

Should it be enquired what it is that constitutes the difference between animal and vegetable life; what it is that lays the line that separates those two great kingdoms from each other, it would be difficult, perhaps we should find it impossible, to return an answer. The power of motion cannot form this distinction, since some vegetables are possessed of motion, and many animals are totally without it. The sensitive plant has obviously a greater variety of motions than the oyster or the pholas. The animal that fills the acorn-shell is immoveable, and can only close its lid to defend itself from external injury, while the flower, which goes by the name of the fly-trap, seems to close upon the flies that light upon it, and that attempt to rifle it of its honey. The animal in this instance, seems to have scarcely a power of self-defence; the vegetable not only guards its possessions, but seizes upon the robber that would venture to invade them. In like manner, the methods of propagation give no superiority to the lower rank of animals. On the contrary, vegetables are frequently produced more conformably to the higher ranks of the creation, and though some plants are produced by cuttings from others, yet the general manner of propagation is from seeds, laid in the womb of the earth, where they are hatched into the similitude of the parent plant or flower. But a most numerous tribe of animals have lately been discovered, which are propagated by cuttings, and this in so extraordinary a manner, that, though the original insect be divided into a thousand parts, each, however small, shall be formed into an animal, entirely resembling that which was at first divided; in this respect, therefore, certain races of animals seem to fall beneath vegetables, by their more imperfect propagation.

What, therefore, is the distinction between them—or are the orders so intimately blended as that it is impossible to mark the boundaries of each? To me it would seem, that all animals are possessed of one power, of which vegetables are totally deficient; I mean either the actual ability, or an awkward attempt at self-preservation. However vegetables may seem possessed of this important quality, yet it is with them but a mechanical impulse, resembling the raising one end of the lever, when you depress the other; the sensitive plant contracts and hangs its leaves indeed, when touched, but this motion no way contributes to its safety; the fly-trap flower acts entirely in the same manner; and though it seems to seize the little animal, that comes to annoy it, yet, in reality, it only closes mechanically upon it, and this inclosure neither contributes to its preservation nor its defence. But it is very different with insects, even of the lowest order; the earth-worm not only contracts, but hides itself in the earth, and escapes with some share of swiftness from its pursuers. The polypus hides its horns; the star-fish contracts its arms, upon the appearance even of distant dangers; they not only hunt for their food, but provide for their safety; and however imperfectly they may be formed, yet still they are in reality placed many degrees above the highest vegetable of the earth, and are possessed of many animal functions, as well as those that are more elaborately formed.

But though these be superior to plants, yet they are very far beneath their animated fellows of existence. In the dress of zoophytes, we may place all those animals, which may be propagated by cuttings, or in other words, which, if divided into two or more parts, each part in time becomes a separate and perfect animal; the head shoots forth a tail, and, on the contrary, the tail produces a head; some of these will bear dividing but into two parts, such is the earth-worm; some may be divided into more than two, and of this kind are many of the star-fish; others still may be cut unto a thousand parts, each becoming a perfect animal; they may be turned inside out, like the finger of a glove; they may be moulded into all manner of shapes, yet still their vivacious principle remains, still every single part becomes perfect in its kind, and after a few days existence, exhibits all the arts and industry of its contemptible parent! We shall, therefore divide zoophytes according to their several degrees of perfection, namely, into worms, star-fish, and polypi; contenting ourselves with a short review of those nauseous and despicable creatures, that excite our curiosity chiefly by their imperfections; it must not be concealed, however, that much has of late been written on this part of natural history. A new mode of animal production, could not fail of exciting not only the curiosity, but the astonishment of every philosopher; many found their favourite systems totally overthrown by the discovery, and it was not without a wordy struggle, that they gave up what had formerly been their pleasure and their pride. At last, however, conviction became too strong for argument, and a question, which owed its general spread rather to its novelty, than to its importance, was given up in favour of the new discovery.

OF WORMS.

The first in the class of zoophytes, are animals of the worm kind, which being entirely destitute of feet, trail themselves along upon the ground, and find a retreat under the earth, or in the water. As these, like serpents, have a creeping motion, so both, in general, go under the common appellation of reptiles; a loathsome, noxious, malignant tribe, to which man by nature, as well as by religion, has the strongest antipathy. But though worms, as well as serpents, are mostly without feet, and have been doomed to creep along the earth on their bellies, yet their motions are very different. The serpent, as has been said before, having a back bone, which it is incapable of contracting, bends its body into the form of a bow, and then shoots forward from the tail; but it is very different with the worm, which has a power of contracting or lengthening itself at will. There is a spiral muscle, that runs round its whole body, from the head to the tail, somewhat resembling a wire wound round a walking-cane, which, when slipped off, and one end extended and held fast, will bring the other nearer to it; in this manner the earth-worm, having shot out, or extended its body, takes hold by the slime of the fore part of its body, and so contracts and brings forward the hinder parts; in this manner it moves onward, not without great effort; but the occasions for its progressive motion are very few.

As it is designed for living under the earth, and leading a life of obscurity, so hath it been adapted to its situation. Its body is armed with small stiff sharp burrs or prickles, which it can erect or depress at pleasure; under the skin there lies a slimy juice, to be ejected as occasion requires, at certain perforations, between the rings of the muscles, to lubricate its body, and facilitate its passage into the earth. Like most other insects, it hath breathing-holes along the back, adjoining each ring; but it is without bones, without eyes, without ears, and properly without feet. It has a mouth, and also an alimentary canal, which runs along to the very point of the tail. In some worms, however, particularly such as are found in the bodies of animals, this canal opens towards the middle of the belly, at some distance from the tail. The intestines of the earth-worm are always found filled with a very fine earth, which seems to be the only nourishment these animals are capable of receiving.

The animal is entirely without brain, but near the head is placed the heart, which is seen to beat with a very distinct motion, and round it are the spermatic vessels, forming a number of little globules, containing a milky fluid, which have an opening into the belly, not far from the head: they are also often found to contain a number of eggs, which are laid in the earth, and are hatched in twelve or fourteen days into life, by the genial warmth of their situation; like snails, all these animals unite in themselves both sexes at once; few that walk out, but must have observed them, with their heads laid against each other, and so strongly attached, that they suffer themselves to be trod upon.

When the eggs are laid in the earth, which, in about fourteen days, as has been said, are hatched into maturity, the young ones come forth very small, but perfectly formed, and suffer no change during their existence: how long their life continues is not well ascertained, but it certainly holds for more than two or three seasons. During the winter, they bury themselves deeper in the earth, and seem, in some measure, to share the general torpidity of the insect tribe. In spring, they revive with the rest of Nature, and on those occasions, a moist or dewy evening brings them forth from their retreats, for the universal purpose of continuing their kind. They chiefly live in a light, rich, and fertile soil, moistened by dews or accidental showers, but avoid those places where the water is apt to lie on the surface of the earth, or where the clay is too stiff for their easy progression under the surface.

Helpless as they are formed, yet they seem very vigilant in avoiding those animals that chiefly make them their prey; in particular, the mole, who feeds entirely upon them beneath the surface, and who seldom ventures, from the dimness of its sight, into the open air; him they avoid, by darting up from the earth the instant they feel the ground move; and fishermen, who are well acquainted with this, take them in what numbers they choose, by stirring the earth where they expect to find them. They are also driven from their retreats under ground, by pouring bitter or acrid water thereon, such as that water in which green walnuts have been steeped, or a lye made of potashes.

Such is the general outline of the history of these reptiles, which, as it should seem, degrades them no way beneath the rank of other animals of the insect creation; but we now come to a part of their history, which proves the imperfection of their organs, from the easiness with which these little machines may be damaged and repaired again. It is well known in mechanics, that the finest and most complicated instruments are the most easily put out of order, and that they are the most difficult to be set aright; the same also obtains in the animal machine. Man, the most complicated machine of all others, whose nerves are more numerous, and powers of action more various, is most easily destroyed: he is seen to die under wounds which a quadruped or a bird could easily survive; and as we descend gradually to the lower ranks, the ruder the composition, the more difficult it is to disarrange it. Some animals live without their limbs, and are often seen to reproduce them; some are observed to live without their brain for many weeks together; caterpillars continue to increase and grow large, though all the nobler organs be entirely destroyed within; some animals continue to exist, though cut in two, their noble parts preserving life, while the others perish that were cut away; but the earth-worm, and all the zoophyte tribe, continue to live in separate parts, and one animal, by the means of cutting, is divided into two distinct existences, sometimes into a thousand!

But there is no phænomenon in all Natural History more astonishing than this, that man, at pleasure, should have a kind of creative power, and out of one life make two, each completely formed, with all its apparatus and functions; each with its perceptions, and powers of motion and self-preservation; each as complete in all respects as that from which it derived its existence, and equally enjoying the humble gratifications of its nature.

When Descartes first started the opinion, that brutes were machines, the discovery of this surprising propagation was unknown, which might, in some measure, have strengthened his fanciful theory. What is life, in brutes, he might have said, or where does it reside? In some we find it so diffused, that every part seems to maintain a vivacious principle, and the same animal appears possessed of a thousand distinct irrational souls at the same time. But let us not, he would say, give so noble a name to such contemptible powers, but rank the vivifying principle in these with the sap that rises in vegetables, or the moisture that contracts a cord, or the heat that puts water into motion! Nothing, in fact, deserves the name of soul, but that which reasons, that which understands, and by knowing God, receives the mark of its currency, and is minted with the impression of its great Creator!

Such might have been the speculations of this philosopher: however, to leave theory, it will be sufficient to say that we owe the first discovery of this power of reproduction in animals to Mr. Trembley, who first observed it in the polypus; and after him, Spalanzani and others found it taking place in the earth-worm, the sea-worm, and several other ill-formed animals of a like kind, which were susceptible of this new mode of propagation. This last philosopher has tried several experiments upon the earth-worm, many of which succeeded according to his expectation; but every earth-worm did not retain the vivacious principle with the same obstinacy; some, when cut in two, were entirely destroyed; others survived only in the nobler part; and while the head was living the tail entirely perished, and a new one was seen to bourgeon from the extremity. But what was most surprising of all, in some, particularly in the small red-headed earth-worm, both extremities survived the operation; the head produced a tail with the anus, the intestines, the annular muscles, and the prickly beards; the tail part, on the other hand, was seen to shoot forth the nobler organs, and in less than the space of three months sent forth a head and heart, with all the apparatus and instruments of generation. This part, as may easily be supposed, was produced much more slowly than the former, a new head taking above three or four months for its completion, a new tail being shot forth in less than as many weeks. Thus two animals, by dissection, were made out of one, each with their separate appetites, each endued with life and motion, and seemingly as perfect as that single animal from whence they derived their origin.

What was performed upon the earth-worm, was found to obtain also in many other of the vermicular species. The sea-worm, the white water-worm, and many of those little worms with feelers, found at the bottom of dirty ditches; in all these the nobler organs are of such little use, that if they be taken away, the animal does not appear to feel the want of them; it lives in all its parts, and in every part, and by a strange paradox in Nature, the most useless and contemptible life is of all others the most difficult to destroy.

OF THE STAR-FISH.

THE next order of zoophytes is that of the star-fish, a numerous tribe, which may be reckoned shapeless and deformed, assuming at various times different appearances. The same animal that now appears round like a ball, shortly after flattens as thin as a plate. All of this kind are formed of a semi-transparent gelatinous substance, covered with a thin membrane, and, to an inattentive spectator, often appear like a lump of inanimate jelly, floating at random upon the surface of the sea, or thrown by chance on shore at the departure of the tide. Upon a more minute inspection, however, they will be found possessed of life and motion; and they will be found to shoot forth their arms in every direction, in order to seize upon such insects as come within their grasp, and to devour them with great rapacity. Worms, the spawn of fish, and even muscles themselves, with their hard resisting shell, have been found in the stomachs of these voracious animals; and what is very extraordinary, though the substance of their own bodies be almost as soft as water, yet they are no way injured by swallowing these shells, which are almost of a stony hardness. They increase in size as all other animals do. In summer, when the water of the sea is warmed by the heat of the sun, they float upon the surface, and in the dark they send forth a kind of shining light greatly resembling that of phosphorus. Some have given these animals the name of sea-nettles, because they burn the hands of those that touch them, as nettles are found to do. They are often seen fastened to the rocks, and to the largest sea-shells, as if to derive their nourishment from them. If they be taken and put into spirit of wine, they will continue for many years entire; but if they be left to the influence of the air, they are, in less than four-and-twenty hours, melted down into limpid and offensive water.

In all of this species, none are found to possess a vent for their excrements, but the same passage by which they devour their food, serves for the ejection of their fæces. These animals, as was said, take such a variety of figures, that it is impossible to describe them under one determinate shape; but in general their bodies resemble a truncated cone, whose base is applied to the rock to which they are found usually attached. Though generally transparent, yet they are observed of different colours, some inclining to green, some to red, some to white, and others to brown. In some, their colours appear diffused over the whole surface, in some they are often streaked, and in others frequently spotted. They are possessed of a very slow progressive motion, and in fine weather they are continually seen, stretching out and fishing for their prey. Many of them are possessed of a number of long slender filaments, in which they entangle any small animals they happen to approach, and thus draw them into their enormous stomachs, which fill the whole cavity of their bodies. The harder shells continue for some weeks indigested, but, at length, they undergo a kind of maceration in the stomach, and become a part of the substance of the animal itself. The indigestible parts are returned by the same aperture through which they were swallowed, and then the star-fish begins to fish for more. These also may be cut in pieces, and every part will survive the operation; each becoming a perfect animal, endued with its natural rapacity. Of this tribe, the number is various, and the description of each would be tedious and uninstructive; the manners and nature of all, are nearly as described; but we shall just make mention of one creature, which, though not properly belonging to this class, yet is so nearly related, that the passing it in silence would be an unpardonable omission.

Of all other animals, the cuttle-fish, though in some respects superior to this tribe, possesses qualities the most extraordinary. It is about two feet long, covered with a very thin skin, and its flesh composed of a gelatinous substance, which, however, within-side, is strengthened by a strong bone, of which such great use is made by the goldsmiths. It is possessed of eight arms, which it extends, and which are probably of service to it in fishing for its prey; while in life, it is capable of lengthening or contracting these at pleasure; but when dead they contract and lose their rigidity. They feed upon small fish, which they seize with their arms; and they are bred from eggs, which are laid upon the weeds along the sea-shore.

The cuttle-fish is found along many of the coasts of Europe, but are not easily caught, from a contrivance with which they are furnished by Nature; this is a black substance, of the colour of ink, which is contained in a bladder generally on the left side of the belly, and which is ejected in the manner of an excrement from the anus. Whenever, therefore, this fish is pursued, and when it finds a difficulty of escaping, it spurts forth a great quantity of this black liquor, by which the waters are totally darkened, and then it escapes, by lying close at the bottom. In this manner the creature finds its safety; and men find ample cause for admiration, from the great variety of stratagems with which various animals are endued for their peculiar preservation.

OF THE POLYPUS.

THOSE animals which we have described in the last chapter are variously denominated. They have been called the star-fish, sea-nettles, and sea-polypi. This last name has been peculiarly ascribed to them by the ancients, because of the number of feelers or feet of which they are all possessed, and with which they have a slow, progressive motion; but the moderns have given the name of polypus, to a reptile that lives in fresh-water, which is by no means so large or observable. These are found at the bottom of wet ditches, or attached to the under surface of the broad-leafed plants that grow and swim on the waters. The same difference holds between these and the sea-water polypus, as between all the productions of the sea, and of the land and the ocean. The marine vegetables and animals grow to a monstrous size. The eel, the pike, and the bream of fresh-waters, are but small; but in the sea they grow to an enormous magnitude. The herbs of the field are at most but a few feet high; those of the sea often shoot forth a stalk of a hundred. It is so between the polypi of both elements. Those of the sea are found from two feet in length to three or four, and Pliny has even described one, the arms of which were no less than thirty feet long. Those in fresh waters, however, are comparatively minute, at their utmost size, seldom above three parts of an inch long, and when gathered up into their usual form, not above a third even of those dimensions.

It was upon these minute animals, that the power of dissection was first tried in multiplying their numbers. ---Indeed, they had been long considered as little worthy the attention of observers, and were consigned to that neglect in which thousands of minute species of insects remain to this very day. It is true, however, that Reaumur observed, classed, and named them. By contemplating their motions, he was enabled distinctly to pronounce on their being of the animal, and not of the vegetable kingdom; and he called them polypi, from the great resemblance to those larger ones that were found on the ocean. But still their properties were neglected, and their history remained unknown.

Mr. Trembley was the gentleman to whom we owe the first discovery of the amazing properties and powers of this little vivacious creature. He divided this class of animals into four different kinds; into those inclining to green, those of a brownish cast, those of a flesh-colour, those which he calls the *polype de panache*. The differences of structure in these, as also of colour, are clearly observable; but the manner of their subsisting, of seizing their prey, and of their propagation is pretty nearly the same in all.

Whoever has taken the pains to look with care into the bottom of a wet ditch when the water is stagnant, and the sun has been powerful, may remember to have seen many little transparent lumps of jelly, about the size of a pea, and flatted on one side; such also as have examined the under side of the broad-leafed weeds that grow on the surface of the water, must have observed them studded with a number of these little jelly-like substances, which were probably then disregarded, because their nature and history were unknown. These little substances, however, were no other than living polypi gathered up into a quiescent state, and seemingly inanimate, because either undisturbed, or not excited by the calls of appetite to action. When they are seen exerting themselves they put on a very different appearance from that when at rest: to conceive a just idea of their figure, we may suppose the finger of a glove cut off at the bottom; we may suppose also several threads or horns planted round the edge like a fringe. The hollow of this finger will give us an idea of the stomach of the animal; the threads issuing forth from the edges may be considered as the arms or feelers, with which it searches for its prey. The animal, at its greatest extent, is seldom seen above an inch and a half long, but it is much shorter when it is contracted and at rest; it is furnished neither with muscles nor rings, and its manner of lengthening or contracting itself, more resembles that of the snail, than worms, or any other insect. The polypus contracts itself more or less, in proportion as it is touched, or as the water is agitated in which they are seen. Warmth animates them, and cold benumbs them; but it requires a degree of cold approaching congelation before they are reduced to perfect inactivity; those of an inch have generally their arms double, often thrice as long as their bodies. The arms, where the animal is not disturbed, and the season not unfavourable, are thrown about in various directions, in order to seize and entangle its little prey; sometimes three or four of the arms are thus employed, while the rest are contracted like the horns of a snail, within the animal's body. It seems also capable of giving what length it pleases to these arms; it contracts and extends them at pleasure, and stretches them only in proportion to the remoteness of the object it would seize.

These animals have a progressive motion, which is performed by that power they have of lengthening and contracting themselves at pleasure; they go from one part of the bottom to another; they mount along the margin of the water, and climb up the side of aquatic plants. They often are seen to come to the surface of the water, where they suspend themselves by the lower end. As they advance but very slowly, they employ a great deal of time in every action, and bind themselves very strongly to whatever body they chance to move upon as they proceed; their adhesion is voluntary, and is probably performed in the manner of a cupping-glass applied to the body.

All animals of this kind have a remarkable attachment to turn towards the light, and this naturally might induce an inquirer to look for their eyes; but however carefully this search has been pursued, and however excellent the microscope with which every part was examined, yet nothing of the appearance of this organ was found over the whole body; and it is most probable that, like several other insects which hunt their prey by their feeling, these creatures are unfurnished with those advantages which would be totally useless for their support.

In the centre of the arms, as was before observed, the mouth is placed, (which the animal can open and shut at pleasure,) and this serves at once as a passage for food, and an opening for it after digestion. The inward part of the animal's body seems to be one great stomach, which is open at both ends; but the purposes for which the opening at the bottom serves are at present unknown, yet certainly not for excluding their excrements, for those are ejected at the aperture by which they are taken in. If the surface of the body of this little creature be examined with a microscope, it will be found studded with a number of warts, as also the arms, more particularly when they are contracted; and these tubercles, as we shall presently see, answer a very important purpose.

If we examine their way of living, we shall find these insects chiefly subsisting upon others, much less than themselves, generally a kind of millepedes that live in the water, and a very small red worm, which they seize with great avidity. In short, no insect whatever, less than themselves, seems to come amiss to them; their arms, as above noticed, serve them as a net would a fisherman, or, perhaps more exactly speaking, as a lime-twig does a fowler. Wherever their prey is perceived, which the animal effects by its feeling, it is sufficient to touch the object it would seize upon, and it is fastened without a power of escaping. The instant one of this insect's long arms is laid upon a millepede, the little insect sticks without a possibility of retreating. The greater the distance at which it is touched, the greater is the ease with which the polypus brings the prey to its mouth. If the little object be near, though irretrievably caught, it is not without great difficulty that it can be brought up to the mouth to be swallowed.—When the polypus is unsupplied with prey, it testifies its hunger by opening its mouth; the aperture, however, is so small that it cannot be easily perceived; but when, with any of its long arms, it has seized upon its prey, it then opens the mouth distinctly enough, and this opening is always in proportion to the size of the animal which it would swallow; the lips dilate insensibly by small degrees, and adjust themselves precisely to the figure of their prey. Mr. Trembley, who took a peculiar pleasure in feeding this useless brood, found that they could devour aliments of every kind, fish and flesh, as well as insects; but he owns they did not thrive so well upon beef and veal, as upon the little worms of their own providing. When he gave one of these famished reptiles any substance which was improper to serve for aliment, at first it seized the prey with avidity, but after keeping it some time entangled near the mouth, it dropt it again with distinguishing nicety.

When several polypi happen to fall upon the same worm, they dispute their common prey with each other. Two of them are often seen seizing the same worm at different ends, and dragging it at opposite directions with great force. And it frequently happens, that while one is swallowing its respective end, the other is also employed in the same manner, and thus they continue swallowing each his part, until their mouths meet together; they then rest, each for some time in this situation, till the worm breaks between them, and each goes off with his share; but it sometimes happens, that a seemingly more dangerous combat ensues, when the mouths of both are thus joined upon one common prey together: the largest polypus then gapes and swallows his antagonist; but what is very wonderful, the animal thus swallowed seems to be rather a gainer by the misfortune. After it has lain in the conqueror's body for about an hour, it issues unhurt, and often in possession of the prey which had been the original cause of contention; how happy would it be for men, if they had as little to fear from each other!

These reptiles continue eating the whole year, except when the cold approaches to congelation; and then, like most others of the insect tribe, they feel the general torpor of nature, and all their faculties are for two or three months suspended; but if they abstain at one time, they are equally voracious at another, and, like snakes, ants, and other animals that are torpid in winter, the meal of one day suffices them for several months together. In general, however, they devour more largely in proportion to their size, and their growth is quick exactly as they are fed; such as are the best supplied, soonest acquire the largest size, but they diminish likewise in their growth with the same facility, if their food be taken away.

Such are the more obvious properties of these little animals, but the most wonderful still remain behind: their manner of propagation, or rather multiplication, has for some years been the astonishment of all the learned of Europe. They are produced in as great a variety of manners as every species of vegetable. Some polypi are propagated from eggs, as plants are from their seed; some are produced by buds issuing from their bodies, as plants are produced by inoculation, while all may be multiplied by cuttings, and this to a degree of minuteness that exceeds even philosophical perseverance.

With respect to such of this kind as are hatched from the egg, little curious can be added, as it is a method of propagation so common to all the tribes of Insect Nature; but with regard to such as are produced like buds from their parent stem, or like cuttings from an original root, their history requires a more detailed explanation. If a polypus be carefully observed in summer, when these animals are chiefly active, and more particularly prepared for propagation, it will be found to bourgeon forth from different parts of its body several tubercles or little knobs, which grow larger and larger every day; after two or three days inspection, what at first appeared but a small excrescence takes the figure of a small animal, entirely resembling its parent, furnished with feelers, a mouth, and all the apparatus for seizing and digesting its prey. This little creature every day becomes larger, like the parent, to which it continues attached; it spreads its arms to seize upon whatever insect is proper for its aliment, and devours it for its own particular benefit; thus it is possessed of two sources of nourishment, that which it receives from the parent by the tail, and that which it receives from its own industry by the mouth. The food which these animals receive frequently tinctures the whole body, and upon this occasion the parent is often seen communicating a part of its own fluids to that of its progeny that grows upon it; while, on the contrary, it never receives any tincture from any substance that is caught and swallowed by its young. If the parent swallows a red worm, which gives a tincture to all its fluids, the young one partakes of the parental colour; but if the latter should seize upon the same prey, the parent polypus is by no means benefited by the capture, but all the advantage remains with the young one.

Yet we are not to suppose that the parent is capable of producing only one at a time; several young ones are thus observed at once, of different sizes, growing from its body, some just budding forth, others acquiring their perfect form, and others again come to sufficient maturity, and just ready to drop from the original stem to which they had been attached for several days. But what is more extraordinary still, those young ones themselves that continue attached to their parent, are seen to bourgeon, and propagate their own young ones also, each holding the same dependence upon its respective parent, and possessed of the same advantages that have been already described in the first connection. Thus we see a surprising chain of existence continued, and numbers of animals naturally produced without any union of the sexes, or other previous disposition of nature.

Thus it appears that the most natural way by which these insects are multiplied; their production from the egg being not so common; and though some of this kind are found with a little bladder attached to their bodies, which is supposed to be filled with eggs, that afterwards come to maturity, yet the artificial method of propagating these animals, is much more expeditious and equally certain: it is equally indifferent whether one of them be cut into ten, or ten hundred parts, each becomes as perfect an animal as that which was originally divided; but it must be observed, that the smaller the part which is separated from the rest, the longer it will be in coming to maturity, or in assuming its perfect form. It would be endless to recount the many experiments that have been tried upon this philosophical prodigy; the animal has been twisted and turned into all manner of shapes; it has been turned inside out, it has been cut in every division, yet still it continued to move; its parts adapted themselves again to each other, and in a short time it became as voracious and industrious as before.

Besides these kinds mentioned by Mr. Trembley, there are various others which have been lately discovered by the vigilance of succeeding observers, and some of these so strongly resemble a flowering vegetable in their forms, that they have been mistaken by many naturalists for such. Mr. Hughes, the author of the Natural History of Barbadoes, has described a species of this animal, but has mistaken its nature, and called it a sensitive flowering plant; he observed it to take refuge in the holes of rocks, and, when undisturbed, to spread forth a number of ramifications, each terminated by a flowery petal which shrunk at the approach of the hand, and withdrew into the hole from whence before it had been seen to issue. This plant, however, was no other than an animal of the polypus kind, which is not only to be found in Barbadoes, but also in many parts of the coast of Cornwall, and along the shores of the continent.

OF THE LYTHOPHYTES AND SPONGES.

It is abundantly probable that the animals we see and are acquainted with, bear no manner of proportion to those that are concealed from us. Although indeed every leaf and vegetable swarms with animals upon land, yet at sea they are still more abundant; for the greatest part of what would seem vegetables growing there, are in fact nothing but the artificial formation of insects, palaces which they have built for their own habitation.

If we examine the bottom of the sea along some shores, and particularly at the mouths of several rivers, we shall find it has the appearance of a forest of trees under water, millions of plants growing in various directions, with their branches entangled in each other, and sometimes standing so thick as to obstruct navigation. The shores of the Persian Gulf, the whole extent of the Red Sea, and the western coasts of America, are so choaked up in many places with these coraline substances, that though ships force a passage through them, boats and swimmers find it impossible to make their way. These aquatic groves are formed of different substances, and assume various appearances. The coral plants, as they are called, sometimes shoot out like trees without leaves in winter; they frequently spread out a broad surface like a fan, and not uncommonly a large, bundling head like a faggot; sometimes they are found to resemble a plant with leaves and flowers; and often the antlers of a stag, with great exactness and regularity. In other parts of the sea are seen sponges of various magnitude, and extraordinary appearances, assuming a variety of fantastic forms like large mushrooms, mitres, fonts, and flower-pots. To an attentive spectator these various productions appear entirely of the vegetable kind; they seem to have their leaves and their flowers, and have been experimentally known to shoot out branches in the compass of a year. Philosophers, therefore, till of late, thought themselves pretty secure in ascribing these productions to the vegetable kingdom; and count Marsigli, who has written very laboriously and learnedly upon the subject of corals and sponges, has not hesitated to declare his opinion, that they were plants of the aquatic kind, furnished with flowers and seed, and endued with a vegetation entirely resembling that which is found upon land. This opinion, however, some time after, began to be shaken by Rumphius, and Jussieu, and at last by the ingenious Mr. Ellis, who by a more sagacious and diligent inquiry into Nature, put it beyond doubt that corals and sponges were entirely the work of animals, and that like the honey-comb, which was formed by the bee, the coral was the work of an infinite number of reptiles of the polypus kind, whose united labours were thus capable of filling whole tracts of the ocean with those embarrassing tokens of their industry.

If in our researches after the nature of these plants, we should be induced to break off a branch of the coraline substance, and observe it carefully, we shall perceive its whole surface, which is exceedingly rugged and irregular, covered with a mucous fluid, and almost in every part studded with little jelly-like drops, which, when closely examined, will be found to be no other than reptiles of the polypus kind. These have their motions, their arms, their appetites exactly resembling those described in the last chapter, but they soon expire when taken out of the sea, and our curiosity is at once stopped in its career, by the animals ceasing to give any mark of their industry; recourse, therefore, has been had to other expedients, in order to determine the nature of the inhabitants as well as the habitation.

If a coraline plant be strictly observed, while still growing in the sea, and the animals upon its surface be not disturbed, either by the agitation of the waters, or the touch of the observer, the little polypi will then be seen in infinite numbers, each issuing from its cell, and in some kinds the head covered with a little shell, resembling an umbrella, the arms spread abroad, in order to seize its prey, while the hinder part still remains attached to its habitation, from whence it never wholly removes. By this time it is perceived that the number of inhabitants is infinitely greater than was at first imagined: and that they are all assiduously employed in the same pursuits, and that they issue from their respective cells, and retire into them at pleasure. Still, however, there are no proofs that those large branches which they inhabit are entirely the construction of such feeble and minute animals. But chymistry will be found to lend a clue to extricate us from our doubts in this particular. Like the shells which are formed by snails, muscles, and oysters, these coraline substances effervesce with acids, and may therefore well be supposed to partake of the same animal nature. But Mr. Ellis went still farther, and examined their operations, just as they were beginning. Observing an oyster-bed which had been for some time neglected, he there perceived the first rudiments of a coraline plantation, and tufts of various kinds shooting from different parts of this favourable soil. It was upon these he tried his principal experiment. He took out the oysters which were thus furnished with coralines, and placed them in a large wooden vessel, covering them with sea-water. In the space of about an hour, he perceived the animals, which before had been contracted by handling, and had shown no signs of life, expanding themselves in every direction, and appearing employed in their own natural manner. Perceiving them, therefore, in this state, his next aim was to preserve them thus expanded, so as to be permanent objects of curiosity. For this purpose, he poured, by slow degrees, an equal quantity of boiling water into the vessel of sea-water in which they were immersed. He then separated each polypus with pincers from its shell, and plunged each separately into small crystal vases, filled with spirit of wine mixed with water. By this method, the animal was preserved entire, without having time to contract itself, and he thus perceived a variety of kinds, almost equal to that variety of productions which these little animals are perceived to form. He has been thus able to observe and describe fifty different kinds, each of which is seen to possess its own peculiar mode of construction, and to form a coraline that none of the rest can imitate. It is true, indeed, that on every coraline substance there are a number of polypi found, in no wise resembling those which are the erecters of the building; these may be called a vagabond race of reptiles, that are only intruders upon the labours of others, and that take possession of habitations, which they have neither art nor power to build for themselves. But in general, the same difference that subsists between the honey-comb of the bee, and the paper-like cells of the wasp, subsists between the different habitations of the coral-making polypi.

With regard to the various forms of these substances, they have obtained different names from the nature of the animal that produced them, or the likeness they bear to some well-known object, such as coralines, fungimadrepores, sponges, astroites, and keratophytes. Though these differ extremely in their outward appearances, yet they are all formed in the same manner by reptiles of various kinds and natures. When examined chymically, they all discover the marks of animal formation; the corals, as was said, dissolve in acids, the sponges burn with an odour strongly resembling that of burnt horn. But we are left somewhat at a loss with regard to the precise manner in which this multitude of cells, which at last assume the appearance of a plant or flower, are formed.

If we may be led in this subject by analogy, it is most certainly probable, that the substance of coral is produced in the same manner that the shell of the snail grows round it; for these little reptiles are each possessed of a slimy matter, which covers its body, and this hardening, as in the snail, becomes a habitation exactly fitted to the body of the animal that is to reside in it; several of these habitations being joined together, form at length a considerable mass, and as most animals are productive in proportion to their minuteness, so these multiplying in a surprising degree, at length form those extensive forests that cover the bottom of the deep.

Thus all Nature seems replete with animated beings; almost every plant on land has its surface covered with millions of these minute creatures, of whose existence we are certain, but of whose uses we are entirely ignorant; while numbers of what seem plants at sea are not only the receptacles of insects, but also entirely of insect formation. This might have led some late philosophers into an opinion, that all Nature was animated; that every, even the most inert mass of matter, was endued with life and sensation, but wanted organs to make those sensations perceptible to the observer: those opinions, taken up at random, are difficultly maintained, and as difficultly refuted; like combatants that meet in the dark, each party may deal a thousand blows without ever reaching the adversary. Those, perhaps, are wiser who view Nature as she offers; who without searching too deeply into the recesses in which she ultimately hides, are contented to take her as she presents herself, and storing their minds with effects rather than with causes, instead of the embarrassments of systems, about which few agree, are contented with the history of appearances, concerning which all mankind have but one opinion.

A CONCISE VIEW OF BOTANY.

The Science of Botany was cultivated in some degree among the ancients, though chiefly with a view to its medical use; but as they adopted no regular system of distribution and arrangement, they made slow progress, and soon lost the knowledge they had gained. The first author on this subject, whose writings now remain, is Hippocrates, who has enumerated about two hundred and fifty plants. After him, Theophrastus, the disciple of Aristotle, who lived about three hundred years before Christ, is the only botanist whose writings can be depended upon as genuine. Among the Romans might be mentioned Cato, Varro, Virgil, and others; but the most eminent were Dioscorides, who lived under Anthony and Cleopatra, and is called the Prince of Botanists, and C. Plinius Secundus. The principal Arabian botanists were, Mesue, Serapio, Razis, Avicenna, and Averrhoes. The succeeding period, till the fifteenth century, proved unfavourable to every science; but about that time botany revived in numerous and laboured commentaries on the old authors. Turner, Gerard, and Tradescant, were the first botanists in England, and applied themselves to this science towards the close of the sixteenth century; but it was after this period that it began to acquire any considerable degree of reputation; and that ingenuity and industry were employed in collecting and classing new species of plants. It would be tedious to recount all those who have distinguished themselves in this respect; suffice it to say, that their united labours have brought botany to a perfection among the moderns, to which the ancients were total strangers, not only as to the method of classing and characterizing plants, but as to the number known and described. Nothing has conduced so much to the cultivation of the science of botany, as the distinct method suggested by modern botanists, by which the several classes, genera, species, and varieties, may be readily distinguished. And in proportion as the system of Linnæus prevails, and different writers agree in adopting the same language, the study must be greatly facilitated. That celebrated writer distributes the systems which have already obtained, into heterodox and orthodox, the former being founded in an alphabetical arrangement in the structure of the root, in the different species of the flowers, in the habits of the plants, their time of flowering, their native soil and climate, their medicinal use, and the order of the dispensaries. The universal systems are four; and Linnæus has distinguished the several patrons of them under the classes of

Fructistæ, Corolistæ, Calycistæ, and Sexualistæ. The first of these are such as form the several classes of vegetables, from the pericarpium, the seed, and the receptacle; the second distinguishes the several classes by means of the corolla and petals; the third distributes them from the calyx; and the last found their system on the different sexes of the plants. This is the system of Linnæus, which is now so generally adopted, that it is useless, in fact, to speak of any other. The sexual system, as its title imports, is founded on a discovery, that there is in vegetables, as well as in animals, a distinction of the sexes. This was not wholly unknown to the ancients, but their knowledge of it was very imperfect. The generality of the flowers of vegetables are hermaphrodite, containing in themselves the character of both sexes; but in the classes Monœcia and Diœcia, the sexes are parted and allotted to different flowers; and in the Diœcia in particular, the sexes are even on different plants, the male growing all on one, and the female on another. This the ancients had observed; indeed, it could hardly escape their notice, as the palm-tree, whose fruit was in esteem among them, being of this class. Very little observation was requisite to teach them, that the flowers of the male was necessary to ripen the fruit of the female; this they must have understood well, as we hear of their sometimes gathering the male flowers and carrying them to the female to assist the operations of nature: but, except in this instance, and some similar notion they had formed respecting the fig, they were so entirely wrong, that it appears they had no real knowledge of the anatomy of flowers. The honour of having first suggested the true sexual system appears to be due to our own countryman, Sir Thomas Millington. Many followed, whose observations proved the truth of this doctrine, which was established beyond a doubt, by Linnæus, in his Fundamenta Botanica and Philosophia Botanica. We shall not attempt to lay before the reader all these proofs: our object is to explain, not to demonstrate: but we shall here mention one fact, which carries conviction with it. In the Philosophical Transactions, vol. xlvii. there is a letter from M. Mylius of Berlin, concerning a remarkable experiment made on the palm-tree. "The sex of plants," (says M. Mylius,) "is very well confirmed by an experiment that has been made here on the palma major foliis flabelli formibus. There is a great tree of this kind in the garden of the Royal Academy. It has flowered and borne fruit these thirty years, but the fruit has never ripened; and planted, it did not vegetate. The palm-tree, as you know, is a planta diœcia, that is, one of those in which the male and female parts of generation are upon different plants: we having, therefore, no male plants, the flowers of our female were never impregnated with the farina of the male. There is a male plant in a garden at Leipsic, twenty German miles from Berlin, from which we procured a branch, and suspended over our female tree; and our experiment succeeded so well that one tree produced more than a hundred perfectly ripe fruit, from which we have already eleven young palm-trees. This experiment has been repeated with still more success. Thus what has been looked upon by many as fabulous, is demonstrated beyond a doubt."

Thus have we given an outline of the history of the science of botany, and explained, as far as is necessary, the new principles upon which the reformation of former vicious systems have been undertaken; but, as our limits will not allow us to enter into a regular systematic elucidation of the whole of the science, we shall content ourselves with giving a description of some of the principal plants.

ACACIA.—The flowers of a species of the acacia are used by the Chinese in making that yellow which we see bears washing in their silks and stuffs, and appears with so much elegance in their painting on paper. They gather the flowers before they are fully open, which they put into a clean earthen vessel over a gentle heat, and stir them continually about, as they do tea leaves, till they become dryish and of a yellow colour; then to half a pound of the flowers they add three spoonfuls of fair water, and after that a little more, till there is just enough to hold the flowers incorporated together: they boil this for some time, and the juice of the flowers mixing with the water, it becomes thick and yellow; they then take it from the fire, and strain it through a piece of coarse silk. To the liquor they add half an ounce of alum, and an ounce of calcined oyster-shells, reduced to a fine powder. All is then mixed together; and this is the fine lasting yellow they have so long used. M. Geoffroy attributes the origin of bezoar to the seeds of this plant; which, being bruised by certain animals, and vellicating the stomach by their great sourness and astringency, cause a condensation of the juices, till at length they become coated over with a stony matter, which we call bezoar.

ACER or MAPLE TREE, of which there are twenty kinds; but the acer saccharinum, or American sugar maple appears to be the most useful. It grows to the height of about forty feet. From this tree the inhabitants of North America make a very good sort of sugar in large quantities, by tapping the trees early in the spring, and boiling the juice. Large tracts in North America are covered with the sugar maple; for it yields a sugar equal to the best from the cane, with no other labour than what women and girls can bestow, in drawing off and boiling the liquor; and when skilfully tapped, they will last many years. It is therefore supposed, that the country can not only supply their own demand, but even make sugar for exportation. We are assured by Dr. Rush, that this tree is so far from being injured by tapping, that it yields the more syrup the oftener it is tapped; and that a tree flourished after forty-two annual operations. From twenty-three gallons and one quart of sap, procured in twenty-four hours from two trees, four pounds and thirteen ounces of good grained sugar have been obtained. A farmer in Pennsylvania, having planted a number of these trees in his meadow, obtained, after twenty years, a pound of sugar from every three gallons of sap annually. The quality of this sugar is superior to that which is made in the West Indies from the cane; and it deposits less sediment when dissolved in water. The Indians of Canada have practised the making of sugar from the maple, time out of mind, and they gained a pound of sugar from eight pints of liquor. The French began to refine it in that country towards the close of the century before the last; and Dr. Robinson sent some of the sugar to Mr. Ray in 1684. A friend of Mr. Ray tried the experiment with our great maple, and obtained a sugar from the juice, but in small quantity.

ACHILLEA or MILFOIL, of which there are twenty-seven kinds. The achillea millefolium, or common milfoil or yarrow, is recommended by Linnæus as an excellent vulnerary and styptic, the fresh herb being bruised and applied; and some foreign physicians recommend it in hæmorrhages. Dr. Hill says, it is excellent in dysenteries, taken in the form of a strong decoction. An ointment is made of it for the piles, and it is reckoned good against the scab in sheep. The variety with purple flowers is not uncommon, and is frequently seen in our gardens. Those who are desirous of having the milfoil for variety will find that they are very hardy, and will thrive almost in any soil, but that they prefer an open exposure. This plant has been generally execrated as a noxious weed in pastures; but it is found to be eaten by cattle, at least by sheep; and has lately been recommended for cultivation.

ACORUS, or SWEET RUSH, received its name from being supposed efficacious in disorders of the eyes. The acorus calamus, or common sweet rush, is sufficiently distinguished by its long sword-shaped leaves, resembling those of the flag, but narrower, and of a brighter green. Linnæus observes, that the root powdered might supply the place of foreign spices; and that it is the only native aromatic plant of northern climates. It has a strong aromatic smell, and a warm, pungent, bitterish taste. The flavour is greatly improved by drying. The roots were commonly imported from the Levant, but those of our own growth are equally as good. The Turks candy them, and regard them as a preservative against contagion. They are also said to have cured agues, when the Peruvian bark has failed. No cattle whatever eat the plant. This plant grows naturally on the banks of rivers, and in standing waters that are shallow. It is found wild in many parts of England, as on Hounslow Heath near Uxbridge, and Harefield, in Middlesex; near Hedley, in Surrey; in the river Yare near Norwich, and about Lynn and Hillington, in Norfolk; in the river Waveney, near Bungay, in Suffolk; near Cambridge; and in many parts of Cheshire. With us it is not very abundant; but it grows plentifully in most of the ditches and standing waters of Holland, and is common in many other parts of Europe.

ADIANTUM, or MAIDENHAIR, of which there are thirty-nine kinds; but of this large genus of ferns one only, the adiantum capillis veneris, or true maidenhair, is a native of Great Britain; the rest being chiefly the growth of hotter climates, particularly the West Indies. Maidenhair is a very succulent plant, yielding almost its whole weight of juice; but neither taste nor smell promise any efficacy. Hallen says, that if the syrop of capillaire, which they make from it, be good for any thing, it is from the orange-flower water which they put into it.

ÆSCULUS HIPPOCASTANUM, or COMMON HORSE CHESNUT. The common horse chesnut is sufficiently known by the beautiful parabolic form in which the branches are disposed when the tree stands single. This tree was in much greater esteem for avenues and walks formerly than at present. It has fallen into disrepute because the leaves decay in the summer; so that it occasions a litter in gardens and plantations, from July till they are all fallen; but notwithstanding this inconvenience, the tree has great merit, for it affords a noble shade very early; and during the time of its flowering no tree has more beauty, for the extremities of the branches are terminated by long spikes of flowers, so that every part of the tree seems covered with them, and being intermixed with the large digitate leaves, they make a noble appearance. In Turkey the nuts are ground, and mixed with the provender for their horses, especially those which are troubled with coughs, or are broken-winded. Hanbury affirms, that swine will fatten on them. Haller relates, that sheep have been fed with nuts whole, and have done very well with them, and that poultry have been kept with them boiled. He also observes, that having a saponaceous quality, they may be used to spare soap in washing; and that the bark of the tree has been given in Italy, not without success, in intermittent fevers. The bark has also been used with good success in dying several sorts of yellow colours. The common horse chesnut is propagated by sowing the nuts, the best time for doing which is early in the spring; but the nuts should be preserved in sand during the winter, otherwise they are apt to grow mouldy and rot.

AGARICUS CAMPESTIUS, or COMMON MUSHROOM or Champignon, is in much request for the table in England. It is eaten fresh either stewed or boiled, and preserved either as a pickle or in powder. The sauce generally called catchup is made from its juice with salt and spices. The wild mushrooms, from fresh undunged pastures, are more delicate than those which are raised on artificial beds, the flesh of the latter being less tender; those who are much accustomed to them can immediately tell the difference by their smell. Miller is of a different opinion, probably because the cultivated ones are more sightly, and may be collected in a proper state for eating more easily.

Althæa Officinalis, or Marsh Mallow, grows naturally in salt marshes, and on the banks of rivers and ditches in Cambridgeshire, Norfolk, and Suffolk; on the sea shores of Cornwall; in Holland, France, Italy, Siberia, &c. It has a perennial root, and an annual stalk, growing erect, to the height of four or five feet, and putting out a few lateral branches. The leaves are soft, angular, and alternate. The flowers appear in June or July, and the seeds ripen in September. The whole plant, particularly the root, abounds with a mild mucilage, which is emollient in a much greater degree than common mallow. The root boiled is much used as an emollient cataplasm; and an infusion of it is generally prescribed, in all cases wherein mild mucilaginous substances are useful, as a pectoral, and in complaints of a gravelly nature. The infusion is much superior to the syrup which is kept in the shops.

Anacardium, or Cashew Nut, or Acajou, is an elegant tree, twenty feet high. The fruit or apple has an agreeable sub-acid flavour, with some degree of restringency. Some of these are of a yellow, and others of a red colour, owing probably to some difference in the soil or culture. The juice expressed from the fruit, and fermented, yields a pleasant wine; and distilled, a spirit is drawn from it which far exceeds arrack or rum, making an admirable punch, and powerfully promoting urine. Some planters in the West Indies roast the ripe fruit, or slice one or two into a bowl of punch, to give it a pleasant flavour. The restringency of the juice has recommended it as a very signal remedy in dropsical habits. The nut springs from one end of the apple. It is of the size and shape of a hare's kidney, but is much larger at the end next the fruit than at the other. The outer shell is of an ash colour, and very smooth; under this is another which covers the kernel; between these there is a thick inflammable oil, which is very caustic; this will raise blisters on the skin, and has often been very troublesome to those who have incautiously put the nuts in their mouths to break the shell. This oil has been used with great success in eating off ring-worms, cancerous ulcers, and corns; but it ought to be applied with caution. It is also esteemed an excellent cosmetic with the West India young ladies, but they must certainly suffer a great deal of pain in its application; and, as fond as our British females are of a beautiful face, it is highly probable they would never submit to be flaved alive to obtain one. When any of the former fancy themselves too much tanned by the scorching rays of the sun, they gently scrape off the thin outside of the stone, and then rub their faces all over with the stone. Their faces immediately swell and grow black; and the skin, being poisoned by the caustic oil above-mentioned, will, in the space of five or six days, come off in large flakes, so that they cannot appear in public in less than a fortnight; by which time the new skin looks as fair as that of a new-born child. The kernel, when fresh, has a most delicious taste, and abounds with a sweet milky juice. It is an ingredient in puddings, &c. When older it is generally roasted; and in this state it is not so proper for costive persons. Ground with cocoa, it makes an excellent chocolate. It is a native of both Indies, and was cultivated in 1699 by the duchess of Beaufort.

Anagallis Arvensis, or Pimpernel, is an annual plant, and flowers from May to August in ploughed grounds and gardens, particularly in sandy soils. The blossoms open about eight in the morning, and close in the afternoon; hence its name of Shepherd's or Poor Man's Weather Glass. But if rain fall, or there be too much moisture in the air, the flowers either do not open, or close up again. Small birds are very fond of the seeds. It was formerly celebrated for its medicinal virtues, and given in maniacal cases, and even in the hydrophobia, but is now fallen into disuse. It appears, however, says Lewis, that it has some claim to the resolvent and detergent qualities which are ascribed to it by some writers. Though a beautiful little plant, being a common weed, it is never cultivated, except in botanic gardens.

Angelica, is a native of the northern parts of Europe. It flowers with us from June to August. The stalks of the garden Angelica were formerly blanched and eaten as celeri. The young shoots are in great esteem among the Laplanders. In Norway bread is sometimes made from the roots. The gardeners near London, who have ditches of water running through their gardens, propagate great quantities of this plant, for which they have a large demand from the confectioners, who make a sweetmeat with the tender stalks of it cut in May. The roots are one of the principal aromatics of European growth, though not much regarded in the present practice. The other parts of the plant have the same flavour, but their active principles are far more perishable. The seeds which come nearest to the roots can scarcely be kept till the spring after they are gathered. These, however, are the only part of the plant which is ordered by the London college, and that only in compound spirit of anniseed. The college formerly directed the roots brought from Spain to be kept in the shops; but they are probably more efficacious on their native northern mountains; and accordingly that direction is now dropped. There are six kinds of angelica.

Aquilegia Vulgaris, or Common Columbine, is found native in most parts of Europe, in woods, hedges, and among bushes. It flowers with us in June. The flowers vary much by culture, and become double either by multiplying the petals or the nectaries. Of all these varieties there are subordinate variations, both in the degree of doubleness, as with two or more rows of petals, two or three rows of nectaries, curiously inserted one into the other; and in the colours, as blue, white, red, purple, flesh-coloured, ash-coloured, chesnut-coloured, and striped or variegated blue and purple, blue and white, red and white. From the different shape of these flowers persons not well skilled in the culture of plants might suppose they were distinct species. The root, the herb, the flowers, the seeds, have been recommended to be used medicinally on good authority; but this plant is of a suspicious tribe, and Linnæus affirms, as of his own knowledge, that children have lost their lives by an over-dose of it. The sensible qualities of the seeds, says Lewis, afford little foundation for their supposed virtues in the jaundice, measles, and small pox; as they do not seem to differ materially from those of the cold seeds, being only somewhat more mucilaginous, with a disagreeable relish. The virtues ascribed to a tincture of the flowers as an antiphlogistic, and for strengthening the gums, and deterging scorbutic ulcers in the mouth, appear to be better founded; the tincture being made with an addition of the vitriolic acid, and differing little from our officinal tincture of roses. The flowers themselves, as well as the conserved and distilled water of them, directed in some foreign pharmacopeias, are insignificant.

Arabis, or Wall Cress, a perennial plant, increasing very fast by its creeping roots, which run obliquely near the surface, and send out fibres at every joint. The root leaves are collected into heads, spreading circularly, and are oblong, whitish, and indented on the edges. From the middle of these heads arise the flowering stems, which grow near a foot high, with leaves on them placed alternately, broader at their base than those which grow below, and closely embracing the stem. The flowers grow in loose bunches towards the top; the petals are white, obtuse, and entire; the calyx is yellowish, shorter by one-third than the corolla. This plant, in its wild state, the more open and airy its situation, the higher it grows, the more it branches, and the more hairy it becomes; in the shade it is almost smooth, quite creeping, with a single stem, the whole plant very pale, and drawn up. Native of the Alps, and other mountains of Europe, on rocks, in caverns, and in woods. It was cultivated in the botanic garden at Oxford in 1658, and is now become very common in gardens; being increased with great facility, and esteemed for its very early flowering, and the pretty appearance it then makes in cold abject situations, where few other things will thrive.

Arbutus, or Strawberry Tree, rises to the height of twenty or thirty feet, but rarely with an upright stem. It usually puts out branches very near the ground. The leaves keep on all the winter, and are thrust off in the spring by new ones, so that it is always clothed with leaves. The berries have many seeds in them, and are roughened with the tubercles of the seeds. The arbutus is now to be found in most of our plantations, and is one of their greatest ornaments in the months of October and November, that being the season when it is in flower, and the fruit of the former year is ripe; for that is a whole year in growing to perfection. When there is plenty both of fruit and flowers upon the trees, they make an elegant appearance, at a season when most others are past their beauty. Those trees which have large oval fruit make the greatest figure, the flowers being larger and oblong. The variety with double flowers is a curiosity, but the flowers, having only two rows of petals, make no great appearance, nor do the trees produce fruit in any quantity; the other therefore is preferable. That with red flowers makes a pretty variety when intermixed with the other; for the outside of them is of a fine red colour at their first appearance, and afterwards they change to a purple, before they fall off. The fruit of this is the same with the common one. Besides these principal varieties the nursery-men have the curled-leaved or cut-leaved, and the smooth-leaved; they also distinguish the broad from the narrow-leaved. The strawberry-tree is a native of the south of Europe, Greece, Palestine, and many other parts of Asia. It is also found in the west of Ireland, in the county of Kerry, near the Lake of Killarney, on barren limestone rocks. The country people eat the fruit in Spain, Italy, &c. Mr. Ray says that he saw it in the market at Padua. It is said to have constituted part of the food of mankind in the early ages. The best method of propagating it is from seeds. When the fruit is perfectly ripe, it should be gathered, and mixed whole with dry sand, to preserve it till the time of sowing.

Argemone, or Prickly Poppy, is an annual plant, rising to the height of two or three feet, with stems armed with prickles. Leaves jagged, soft, shining, with the points of the jags ending in sharp yellow spines: on the upper side are milky veins, as in our lady's thistle; on the under are small prickles, along the midrib and veins. Seeds very numerous, round, black, rough, with a compressed scar on one side. The Spaniards brought it from Mexico to Europe, under the title of the devil's fig, which name it obtained from the form of the fruit, armed, as Parkinson observes, with cruel sharp prickles or thorns. It is now found in a wild state in some of the southern countries of Europe, and was cultivated by Gerard in 1597. It flowers in July and August. The whole plant abounds with a milky glutinous juice, which turns in the air to a fine bright yellow; and when reduced to consistence is scarcely distinguishable from gamboge.

In very small doses it is probably of equal efficacy given in dropsies, jaundices, and cutaneous eruptions. The seeds are said to be a much stronger narcotic than opium. In the West Indies it is called the yellow thistle.

Artemisia, or Southernwood, is an under shrub, seldom rising more than three or four feet high. It is bitter and aromatic, with a very strong smell. It is not much in use, but promises considerable effects; outwardly, in discussing contusions and tumours; inwardly, for destroying worms, and in disorders peculiar to the female sex. In catarrhal malignant fevers it may have great efficacy, by its quality of promoting perspiration, which it possesses in a high degree. A table-spoonful of the expressed juice may be given, half an ounce of the decoction, or a whole ounce of the infusion of the herb. In the present practice it is scarcely otherwise made use of than as an ingredient in discutient and antiseptic fomentations, and for this purpose only it is ordered by the medical college of London. The branches dye wool a deep yellow.

Artacarpus, or Bread-fruit Tree, grows to the height of thirty or forty feet, with a trunk of the thickness of the human body. The aments on the outmost branches are violet-coloured, peduncled, male and female on the same twig. The whole tree, and the fruit before it is ripe, abound in a very tenacious milky juice, that may be drawn out into threads. Wherever the tree is wounded, it pours out a glutinous milky liquor. The branches form an ample, almost globular, head: the lower ones, which are the longest, spring from the trunk ten or twelve feet above the ground, spreading out almost horizontally; twigs ascending, bearing flowers and fruits at their ends. The younger leaves, like all the more tender parts of the tree, are glutinous to the touch. The male flowers are among the upper leaves; and the female flowers at the end of the twigs. The fruit is about the size of a child's head, sometimes having abortive seeds, and sometimes none. It flowers and produces ripe fruit twice in the year. When the fruit is ripe it is yellow and soft, and the taste is sweet and pleasant. The natives of Guam use it for bread; they gather it when full grown, while it is green and hard, and then bake it in an oven, which scorches the rind and makes it black; but they scrape off the outside black crust, and there remains a tender thin crust, and the inside is soft, tender, and white, like the crumb of a two-penny loaf. There is neither seed nor stone in the inside, but all is of a pure substance like bread. It must be eaten new; for if it be kept above twenty-four hours, it becomes dry and choaky, but it is very pleasant before it gets too stale. This fruit lasts in season eight months in the year, during which time the natives eat no other sort of food of the bread kind. It affords a great deal of nourishment, and is very satisfying; and being of a gently astringent quality, is good for persons of a lax habit. It is more nourishing boiled with fat meat, than roasted on coals. The milky juice, which distils from the trunk, boiled with cocoa-nut oil, makes a very strong bird-lime. It is a native of Amboyna, Banda, and others of the Molucca Islands; of Java, and others of the Maldiva Islands; of Timor, Balega, Madura; of Prince's Island, &c. It was introduced into the West India islands towards the close of the last century. Every good man will certainly rejoice, that by a humane and well-concerted plan, the bread-fruit tree, with many other useful fruits and plants, has been established in the West Indies, by the kind attention of the British government, the exemplary and disinterested exertions of Sir Joseph Banks, and the zealous care of Captain Bligh.

Asparagus, or Spherage, is a well-known plant. Mr. Miller is of opinion, that the common asparagus, which is cultivated for the use of the table, may have probably been brought by culture to the perfection it now is, from the wild sort, which grows naturally in the fens of Lincolnshire, where the shoots are no larger than straws; but if so, it must have been from very long culture and good management; for a friend of mine, says he, procured some seeds of the wild sort, which he cultitivated with great care, in very rich ground, but could not bring the roots to produce shoots more than half the size of the garden kind, which grew on the same ground; but he always found the wild sort came up a week or ten days earlier in the spring, and the shoots were exceedingly sweet. The young shoots are generally esteemed in the spring, and are cultivated for the table, especially near London, in great abundance. According to Dr. Withering, they are nutritious; but Lewis, on the contrary, says, they are supposed to promote appetite, but afford little nourishment. What is more certain is, that they impart a very strong smell to the urine in a very little time after being eaten; and for this reason they are accounted by some an useful diuretic; by others, however, they are supposed to be injurious to the kidnies. But it does not appear from common experience that they possess either of these qualities in any considerable degree. The garden asparagus is propagated by seeds, in the procuring of which there should be particular care to get it from a person of skill, who may be depended upon for his choice of the shoots, and integrity in supplying with his best seeds.

Atriplex Hortensis, or Garden Orach, has a stem three feet and more; the leaves are pale green, and of a slightly acid flavour. It is a native of Tartary, and is used by many, says Parkinson, boiled and buttered, to make the stomach and belly soluble; and is put among other herbs to make pottage. There are many dishes of meat made with it while it is young, for, being almost without flavour, it is more convertible into what relish any one may chuse to make it, with sugar, spices, &c.

The red orach is found to dye wool of a good olive colour. It was formerly cultivated in the kitchen garden as a culinary herb, being used as spinage, and is now, by some persons, preferred to it; though, in general, it is not esteemed among the English; but the French cultivate it for use.

Atropa Mandragora, or Mandrake, has a long taper root shaped like a parsnip, which runs three or four feet deep in the ground: it is sometimes single, and at others divided into two or three branches, almost of the colour of the parsnip, but a little darker. Immediately from the crown of the root arises a circle of leaves, which at first stand erect, but when grown to their full size, spread open, and lie upon the ground: they are more than a foot in length, and are four or five inches long in the middle, growing narrow toward both ends, of a dark green colour, and a fetid scent. It is a native of Spain, Portugal, Italy, and the Levant. It flowers here in March, and the seeds are ripe in July.

Avena, or Oat, has an annual root, and the culm or straw is two feet high and upwards. No botanist has been able to ascertain satisfactorily the native place of growth of this or any other sort of grain now commonly cultivated in Europe. There are three sorts of oats cultivated in England, viz. the white, the black, and the brown or red oat. The white sort is the most common about London, makes the whitest meal, and is chiefly cultivated where the inhabitants live much upon oat cakes. The black is more cultivated in the northern parts of England, and is esteemed a hearty food for horses. The red oat is much cultivated in Derbyshire, Staffordshire, and Cheshire, but is rarely seen in any of the counties near London, though it is a very hardy sort, and gives a good increase; it would be well worth propagating, especially in strong land. The oat is a very profitable grain, and esteemed the most wholesome food for horses, being sweet, and of an opening nature: other sorts of grain are apt to bind, which is injurious to labouring horses; but if they be fed with this grain soon after it is housed, before it has had a sweat in the mow, or has been otherwise dried, it is as bad on the other hand, for it is then too laxative. This grain is a great improvement to many estates in the north of England, Scotland, and Wales; for it will thrive on cold barren soils, which will produce no other sort of grain: it will also thrive on the hottest land. In short, there is no soil too rich or too poor, too hot or too cold, for it; and in wet harvests, when other grain is spoiled, this will receive little or no damage; the straw and husks being of so dry a nature, that, if they be housed wet, they will not heat in the mow, or become mouldy, as other grain usually do; it is therefore of great advantage in the north of England, and in Scotland, where their harvest is generally late, and the autumns wet. The meal of this grain makes tolerably good bread, and is the common food of the country people in the north. In the south it is esteemed for pottage, and in some places they make beer with it. The best time for sowing oats is in February or March, according as the season is early or late; and sometimes, when sown in April, upon cold land, they have been early ripe. The black and red oats may be sown a month earlier than the white, because they are hardier.

Hordeum, or Barley, is emollient, moistening, and expectorating; and it was chosen by Hippocrates as a proper food in inflammatory distempers. The principal use of barley among us is for making beer; in order to which it is first malted. The Spaniards, among whom malt liquors are little known, feed their horses with barley as we do with oats. In Scotland, barley is a common ingredient in broths; and the consumption of it for that purpose is very considerable, barley-broth being a dish as frequent there as that of soup in France. Pearl Barley and French Barley, are barley freed from the husk by a mill; the distinction between the two being, that the pearl barley is reduced to the size of a small shot, all but the very heart of the grain being ground away.

Bartsia Viscosa, or Yellow Marsh Eyebright, has a stem a foot high, upright, and cylindric. The whole plant is clammy. It is an annual plant, and is a native of France, Italy, and Britain; in the marshes of Cornwall, Devonshire, Lancashire, and Staffordshire, and of Argyleshire in Scotland. It flowers in July and August.

Bellis, or The Daisy, is a native of most parts of Europe in pastures; it flowers almost all the year, and shuts up close every night and in wet weather. The taste of the leaves is somewhat acrid; but in some countries it is useful as a potherb. The roots have a penetrating pungency. It is ungrateful to cattle, and even to geese; it occupies therefore a large share of pasture lands, to the exclusion of grass and profitable herbs. It has been much recommended as excellent for fresh wounds externally, and against inflammatory disorders internally; but it is now wholly out of use. Varieties of the garden daisy are double white, red, white and red striped, variegated, scarlet, and pied. Double cock's comb shaped, white, red, and speckled. Poliferous, childing or hen and chicken daisy. The bellis annua, or annual daisy, is a low annual plant, seldom rising more than three inches high, with an upright stalk, having leaves on the lower part, but the upper part naked, and supporting a single flower like that of the common daisy, but smaller.

Berberis, or Barberry, is a shrub rising to the height of eight or ten feet. The stems are upright and branched, smooth and slightly grooved, brittle, with a large white pith, and covered with a whitish or ash-coloured bark, which is yellow on the inside. Both stems and branches are armed with large thorns, which commonly grow by threes. The berries are at first green, but when ripe they turn to a fine red colour. It is a native of the eastern countries, and now of most parts of Europe, in woods, coppices, and hedges. In England, chiefly in a chalky soil, as particularly about Saffron Walden in Essex. The flowers appear in May, and the fruit ripens in September. There are many varieties of this shrub, and the leaves of this kind are gratefully acid. The berries, being boiled with sugar, form a most agreeable rob or jelly; they are used likewise as a sweetmeat, and are put into sugar plumbs or comfits. The roots boiled in lye yield a yellow colour; and in Poland they dye leather of a fine yellow with the bark of the root. The inner bark of the stems will also dye linen, of a fine yellow, with the assistance of alum. Kine, sheep, and goats, are said to eat it; horses and swine to refuse it. The fruit of the barberry is considered as a mild restringent acid, agreeable to the stomach, and of efficacy in hot bilious disorders and in a putrid disposition of the humours. The barberry is common in the hedges about Saffron Walden in Essex, and many miles round that place. It is propagated by suckers, which are put out in great plenty round the root.

Beet.—The garden red beet has large, thick, succulent leaves, which are for the most part of a dark red or purple colour. The roots are large and deep red, and on these circumstances their goodness depends; for the larger they grow the more tender they will be, and the deeper their colour the more they are esteemed. It is a native of the sea-coast of the southern parts of Europe. Of this species there are many seminal varieties; for the beet is very subject to change, and to degenerate, at least in our climate. The roots of red beet are boiled, sliced, and eaten cold by themselves, or in sallads; are used as garnish to dishes, and as a pickle. The green-leaved variety is most esteemed; the roots being the largest and most tender. A good sugar may be obtained from the juice of the fresh roots. The red beet is frequently sown with carrots, parsnips, or onions, by the kitchen gardeners near London, who draw up their carrots or onions when they are young, whereby the beets will have room to grow when the other crops are gathered; but where the crops are not timely removed from them, it will be a better method to sow them separately.

Betony, or Wood Betony, has an upright stem, a foot high or more, not branched, or but very little, in its wild state, being hairy, channelled, and the corners rounded. It is a native of woods, heaths, and pastures among bushes; flowering from the beginning of July to September. Betony was much used in medicine, but it is discarded from modern practice. When fresh it intoxicates. The leaves, when dry, excite sneezing. Sheep eat it, but goats refuse it. This plant dyes wool of a fine deep yellow.

Betula, or Birch Tree.—The common birch tree is known by the silvery colour of the bark, or rather the outer thin covering to the bark; the smallness of the leaves in comparison with other timber trees; and the lightness and airiness of the whole appearance. It is of a middling, or rather inferior, size among other forest trees. The branches are alternate, subdivided, very pliant and flexible, covered with a reddish brown or russet smooth bark, generally dotted with white. It is a native of Europe, from Lapland to the sub-Alpine parts of Italy. It flowers with us in April or May. The wood of our birch is very white; and women's shoe-heels and pattens, and packing-cases, are made of it. It is planted along with hazel, to make charcoal for forges. In the northern parts of Lancashire they make a great quantity of besoms with the twigs for exportation.

Coffea, or The Coffee Tree of Arabia seldom rises above sixteen or eighteen feet in its native country, or more than ten or twelve in Europe. The main stem grows upright, and is covered with a light brown bark. The leaves generally continue three years. The flowers are produced in clusters (two to four) at the base of the leaves, sitting close to the branches; they are of a pure white, with a very grateful odour, but of short duration; they are succeeded by berries, which are first green, but turn red when fully grown, and change to black when ripe. They are of an oblong spheroidal form, with a little circular area at the top, within which is a callous dot; the pulp is pale, insipid, and gelatinous; within, it is two-celled, and the partition is fleshy and vascular; this is the only receptacle, and penetrates the cleft of the seeds. In each cell is one seed only, of an elliptic form, convex on one side, flat on the other, with a longitudinal cleft, of a pale glaucous colour, loosely covered with an elastic diaphanous aril, of the substance of paper. The liquor which we call coffee, prepared from the berry of this tree, is said to have been drank in Ethiopia from time immemorial. The Galla, a wandering nation of Africa, in their incursions on Abyssinia, being obliged to traverse immense deserts, and being also desirous of falling on the Abyssinians without warning, that they may be encumbered as little as possible with baggage, carry nothing with them to eat, but coffee roasted till it can be pulverised, and then mixed with butter into balls, and put into a leathern bag. One of these, about the size of a billiard ball, keeps them, they say, in strength and spirits during a whole day's fatigue, better than a loaf of bread or a meal of meat. It was introduced into Aden in Arabia from Persia, by Gemaleddin, only about the middle of the fifteenth century. Not long after, it reached Mecca, Medina, &c. and Grand Cairo. Hence it continued its progress to Damascus and Aleppo, and in

1554 became known at Constantinople, being introduced there by two persons whose names were Shems and Hekin; one from Damascus, the other from Aleppo: each of these men opened a public coffee-house in that city. It is not certain at what time the use of coffee passed from Constantinople to the western parts of Europe; but it is probable that the Venetians, on account of the proximity of their dominions, and their great trade to the Levant, were the first acquainted with it; and Pietro della Valle, a Venetian, in a letter from Constantinople, written in 1615, tells his friend, that upon his return he should bring him some coffee, which he believed was a thing unknown in his country. It was known at Marseilles in 1644; but till the year 1660 it was drank only by such as had been accustomed to it in the Levant; but that year some bales of it were imported from Egypt; and in 1671 a coffee-house was opened at Marseilles. The use of coffee was introduced into England some years earlier; for in 1652 Mr. Daniel Edwards, a Turkey merchant, brought home with him a Ragusian Greek servant, whose name was Pasqua Rosse, and who understood the roasting and making of coffee. This servant was the first who sold coffee, and kept a house for the purpose in George-yard, Lombard-street; or rather, according to Mr. Houghton, in a shed in the church-yard of St. Michael's, Cornhill, which is now, says he, (1701) a scrivener's brave house. The first mention of coffee in our statute books was in 1660, 12 Car. II. c. 24. In 1688 Mr. Ray affirms, that London might rival Grand Cairo in the number of its coffee-houses; and that they were to be found not only in the capital, but in every town of note in England. Probably the ill-judged proclamation of Charles II. in 1675 against coffee-houses, contributed much to establish them. The first plant which appeared in Jamaica, was carried there by Sir Nicholas Laws, and placed in the garden of Townwell, at present called Temple-hall, the property of Mr. Lutterell. But he dying in 1731, did not see the cultivation of it make any considerable progress. In the year 1752 the export of coffee from Jamaica was rated at 60,000 pounds weight; in 1775 it was 440,000 pounds. The Abbé Raynal says, that 12,550,000 pounds weight is annually exported from Arabia Felix. Dr. Patrick Browne, who resided many years in Jamaica, informs us, that the coffee-tree thrives best in a rich soil and cool shaded situation, where it produces so great a quantity of fruit, that the branches can hardly sustain the weight, and even the very trunk yields to the load. As the coffee-tree is an evergreen, it makes a beautiful appearance at every season in the stove, but particularly when it is in flower; and also when the berries are red, which is generally in winter; as they continue a long time in that state, there is scarcely any plant that more deserves a place in the stove than this. It is propagated by the berries, which must be sown soon after they are gathered from the trees; for if they be kept out of the ground a fortnight, they will not grow. This has constantly happened every where, for the berries sent from Holland to Paris did not grow, nor did those which were sent from Paris to England; so that, wherever these trees are desired, the young plants must be sent, if it be at any distance from the place where they grow. In Arabia Felix the coffee-tree is raised from seed, sown in nurseries, and planted out as there is occasion.

Bubon, or Macedonian Parsley, sends out many leaves from the root, the lower growing almost horizontally, spreading near the surface of the ground; the foot stalk of each leaf divides into several other smaller, garnished with smooth rhomb-shaped leaves, which are of a bright pale green colour, indented on the edges. In the centre of the plant arises the flower-stem, which is littte more than a foot high, dividing into many branches, each being terminated by an umbel of white flowers, which are succeeded by oblong hairy seeds. They are of a bay brown colour on the convex side, marked with five raised pale lines, and beset all about with hoary hairs; on the other side they are flat, or very slightly concave. Lowreiro says, that the stem is annual, upright, straight, with many ascending branches; the fruit oblong, ovate, slender, and very strong-scented. It is a native of Greece and Barbary; and probably of the East Indies. It flowers with us in July, or from June to August. In warm countries it is biennial, but in England the plants seldom flower till the third or fourth year from seed; but whenever they flower they always die. It was cultivated by John Gerard in 1596. In some parts of the east they use this plant to scent their clothes: the smell is very strong, and rather disagreeable to Europeans. The plant, but especially the seed, is esteemed to be diuretic, emenagogue, and carminative; the seeds are an ingredient in theriaca.

Myristica, the Nutmeg Tree; of which there are three species, having several varieties. 1. *Myristica Fatua*, the *Wild Nutmeg*, grows in Tobago, and rises to the height of an apple tree; has oblong, lanceolated, downy leaves, and hairy fruit; the nutmeg of which is aromatic, but when given inwardly is narcotic, and occasions intoxication, delirium, and madness for a time. 2. *Myristica Moschata*, the *Nutmeg Tree*, attains the height of 30 feet, producing numerous branches, which rise together in stores, and are covered with bark, which on the trunk is of a reddish brown, but that on the young branches is of a bright green colour. The leaves are nearly elliptical, pointed, undulated, obliquely nerved, on the upper side of a bright green, on the under whitish, and stand alternately upon footstalks: the flowers are small, and hang upon slender peduncles, proceeding from the axillæ of the leaves: they are both male and female upon separate trees. M. de la Marck has described and figured this and other species of the myristica with tolerable accuracy. The kernels, called nutmegs, are well known, and have been long used both for culinary and medical purposes. Distilled with water, they yield a large quantity of essential oil, resembling in flavour the spice itself; after the distillation, an insipid sebaceous matter is found swimming on the water; the decoction inspissated, gives an extract of an unctuous, very slightly bitterish taste, and with little or no astringency. Rectified spirit extracts the whole virtue of nutmegs by infusion, and elevates very little of it in distillation; hence the spirituous extract possesses the flavour of the spice in an eminent degree. Nutmegs, when heated, yield to the press a considerable quantity of limpid yellow oil, which on cooling concretes into a sebaceous consistence. In the shops we meet with three sorts of unctuous substances, called oil of mace, though really expressed from the nutmeg. The best is brought from the East Indies in stone-jars; this is of a thick consistency, of the colour of mace, and has a very agreeable fragrant smell: the second sort, which is paler coloured, and much inferior in quality, comes from Holland in solid masses, generally flat, and of a square figure: the third, which is the worst of all, and usually called common oil of mace, is an artificial composition of sevum, palm-oil, and the like, flavoured with a little genuine oil of nutmeg. When the fruit is ripe, the natives ascend the trees, and gather it by pulling the branches to them with long hooks. Some are employed in opening them immediately, and in taking off the green shell or first rind, which is laid together in a heap in the woods, where, after some time, it putrifies. As soon as the putrifaction has taken place, there spring up a kind of mushrooms, called boleti moschatyni, of a blackish colour, and much valued by the natives, who consider them as delicate eating. When the nuts are stripped of their first rind they are carried home, and the mace is carefully taken off with a small knife. The mace, which is of a beautiful red, but afterwards assumes a darkish or reddish colour, is laid to dry in the sun for the space of a day, and is then removed to a place less exposed to his rays, where it remains for eight days, that it may soften a little. They afterwards moisten it with sea-water, to hinder it from drying too much, or from losing its oil. They are careful, however, not to employ too much water, lest it should become putrid, and be devoured by the worms. The medicinal qualities of nutmeg are esteemed aromatic, anodyne, stomachic, and restringent; and it has been much used in diarrhœas and dysenteries. To many people the aromatic flavour of nutmeg is very agreeable; they however should be cautious not to use it in large quantities, as it is apt to affect the head, and even to manifest an hypnotic power, in such a degree as to prove dangerous. Bontius speaks of this as a frequent occurrence in India: and Dr. Cullen relates a remarkable instance of this soporific effect, which fell under his own observation, and hence concludes that in apoplectic and paralytic cases this spice may be very improper. He observes, that a person by mistake took two drachms or a little more of powdered nutmeg: he felt it warm in his stomach, without any uneasiness; but in about an hour after he had taken it he was seized with a drowsiness, which gradually increased to a complete stupor and insensibility; and not long after he was found fallen from his chair, lying on the floor of his chamber in the state mentioned. Being laid a-bed he fell asleep; but waking a little from time to time, he was quite delirious; and he thus continued alternately sleeping and delirious for several hours. By degrees, however, both these symptoms diminished; so that in about six hours from the time of taking the nutmeg he was pretty well recovered from both. Although he still complained of head-ach, and some drowsiness, he slept naturally and quietly the following night, and next day was in his ordinary health. Mace possesses qualities similar to those of the nutmeg, but is less astringent, and its oil is supposed to be more volatile and acrid. Nutmeg trees grow in several islands in the eastern ocean. The wood pigeon of the Moluccas is a planter of these trees. The Dutch long monopolized the trade.

Pistachia Terebinthus, or Pistachia Tree, grows naturally in Arabia, Persia, and Syria, whence the nuts are annually brought to Europe. In those countries it grows to the height of twenty-five or thirty feet; the bark of the stem and old branches is of a dark russet colour, but that of the young branches is of a light brown. Pistachia Lentiscus, or Common Mastich Tree, grows naturally in Portugal, Spain, and Italy. Being an evergreen, it has been preserved in this country in order to adorn the green-houses. In the countries where it is a native, it rises to the height of eighteen or twenty feet. Pistachia Orientalis, or true Mastich Tree of the Levant, from which the mastich is gathered, has been confounded by most botanical writers with the lentiscus, or common mastich tree above-mentioned, though there are considerable differences between them. Pistachia nuts are moderately large, containing a kernel of a pale greenish colour, covered with a reddish skin. They have a pleasant, sweet, unctuous taste, resembling that of almonds; and they abound with a sweet and well-tasted oil, which they yield in great abundance on being pressed after bruising them: they are reckoned amongst the analeptics, and are wholesome and nutritive; and are by some esteemed very proper to be prescribed by way of restoratives, eaten in small quantity, to people emaciated by long illness.

Myrtus, the Myrtle; of which the following are the principal species: Myrtus Communis, the Common Myrtle Tree, rises with a shrubby, upright, firm stem, branching numerously all around into a close full head, rising eight or ten feet high; very closely garnished with oval, lanceolate, entire, mostly opposite leaves, from half an inch to an inch and a half long, and one broad, on short foot-stalks; and numerous, small, pale flowers from the axillas, singly on each foot-stalk, having diphyllous involucrums; each flower succeeded by a small, oval, dark purple berry. This species has many varieties. *Myrtus Pimenta, Pimento, Jamaica Pepper,* or *Allspice Tree,* grows above thirty feet in height and two in circumference; the branches near the top are much divided, and thickly beset with leaves, which by their continual verdure always give the tree a beautiful appearance; the bark is very smooth externally, and of a grey colour; the leaves vary in shape and in size, but are commonly about four inches long, veined, pointed, elliptical, and of a deep shining green colour; the flowers are produced in bunches or panicles, and stand upon subdivided or trichotomous stalks, which usually terminate the branches; the calyx is cut into four roundish segments; the petals are also four, white, small, reflex, oval, and placed opposite to each other between the segments of the calyx; the filaments are numerous, longer than the petals, spreading, of a greenish white colour, and rise from the calyx and upper part of the germen; the antheræ are roundish, and of a pale yellow colour; the style is smooth, simple, and erect; the stigma is obtuse; the germen becomes a round succulent berry, containing two kidney-shaped flattish seeds. This tree is a native of New Spain and the West Indian islands. In Jamaica it grows plentifully; and in June, July, and August, puts forth its flowers, which, with every part of the tree, breathe an aromatic fragrance. The berries when ripe are of a dark purple colour, and full of a sweet pulp, which the birds devour greedily, and muting the seeds, afterwards propagate these trees in all parts of the woods. It is thought that the seeds passing through them, in this manner, undergo some fermentation, which fits them better for vegetating than those gathered immediately from the tree. The pimento is a most beautiful odoriferous evergreen, and exhibits a fine variety in the stove at all seasons. It flowers with great beauty and luxuriance. Pepper is an aromatic berry, of a hot dry quality, chiefly used in seasoning. All the species of pepper possess a strong aromatic smell, and a hot pungent taste. The long sort, being the most powerful, is generally employed for medicinal purposes; the black is chiefly used in culinary preparations. On account of their heating and stimulating properties, however, the use of every sort requires some circumspection. Pepper is an excellent spice, which should always be coarsely ground, and eaten only with animal food; with cabbages, cucumbers, and other flatulent and cold vegetables; and likewise with fish, and all substances difficult to be digested. On the continent this spice is highly esteemed for its efficacy in relieving flatulency, weak or impaired digestion, and the giddiness which generally accompanies the complaint last mentioned. For this purpose from six to ten grains are directed to be swallowed every morning, previously to taking food; but such practice ought to be adopted only in cases where the stomach is in a high degree vitiated, or the patient has been habituated to the free use of spices and spirituous liquors.

Plantago, or Plantain, the most noted of which are, 1. The *common broad-leaved plantain,* called *Weybread;* 2. The *great hoary plantain,* or *lamb's tongue;* 3. The *narrow leaved plantain,* or *ribwort;* and several varieties have been found in England, which are accidental; the *besom plantain* and *rose plantain.* The plantains grow naturally in pastures in most parts of England, and are frequently very troublesome weeds. The common plantain and ribwort plantain are both used in medicine, and are so well known as to need no description. They are said to be slightly astringent, and the green leaves are commonly applied to fresh wounds by the common people. The Jamaica plantain is a handsome plant, an engraving of which accompanies the present work. There are thirty-eight species of the plantain.

Phillyrea, or Mock Privet, of which there are three species, distinguished by the form and indentations of their leaves; they are shrubs, and natives of the southern countries of Europe; they are evergreens, and sufficiently hardy to thrive in the open air, being rarely injured, except in very severe winters, which cause their leaves to fall, and kill some of their weaker branches; these are repaired by new shoots the following summer. Few evergreens are hardier than the phillyrea, or deserve more to be cultivated for pleasure.

Gnaphalium, Cudweed, Goldylocks, Eternal or Everlasting Flower, a genus of the Polygamia Superflua order, and Syngenesia class of plants; natural order, Compositæ. Calyx imbricate, with the marginal scales rounded, scariose, coloured; down feathered; receptacle naked. There are sixty-six species, which are chiefly under-thrubs or herbs; the leaves are alternately placed, generally hoary; the flowers usually terminate the stem and branches in globes or corymbs. The calyx is permanent, with yellow or white scales. If the flowers of gnaphalium are gathered before they are much opened, the heads will continue in beauty many years, if kept from air and dust. According to Haller, all the flowers are androgynous; and have been formerly recommended as attenuants, discutients, and diaphoretics, but are not used in modern practice. It is a native of Germany, France, Spain, and Istria.

Narcissus Jonquilla, the Jonquil, sometimes called the Rush-leaved Daffodil, hath an oblong, bulbous, brown root; sending up several long, semi-taper, rush-like, bright green leaves; amidst them an upright green flower-stalk, a foot or fifteen inches high; terminated by a multiflorous spatha, protruding many yellow flowers, often expanded like a radius, each having a hemispherical, crenated nectarium, shorter than the petals; flowering in April, and mostly of a fine fragrance. The varieties are, *Jonquil Minor*, with single flowers; *Jonquil Major* with single flowers; starry-flowered; yellow and white-flowered; white-flowered; semi-double-flowered; double-flowered; and large *Double inodorous Jonquil*: all multiflorous, the singles in particular; but sometimes the doubles produce only two or three flowers from a spatha, and the singles commonly six or eight. All the sorts have so fine a shape, so soft a colour, and so sweet a scent, that they are looked upon as some of the most agreeable spring flowers. *Narcissus Tazeta*, the *Multiflorous Daffodil*, commonly called polyanthus narcissus, hath a very large, roundish, bulbous root; long, narrow, plain leaves; an upright flower-stalk, rising from ten or twelve inches to a foot and half high, terminated by a multiflorous spatha, protruding many large, spreading, white and yellow flowers, in a cluster, having bell-shaped nectariums shorter than the corolla; flowering in February, March, and April; and is exceedingly fragrant. The varieties of this are very numerous. They are all pretty flowers, and make a charming appearance in the flower-borders, &c.; they are also finely adapted for blowing in glasses of water, or in pots, to ornament rooms in winter.

NARDUS, or SPIKENARD, is a plant which was highly valued by the ancients, both as an article of luxury and medicine. The unguentum nardinum was used at baths and feasts as a favourite perfume. Its value is evident from that passage of Scripture, where our Saviour's head was anointed with a box of it, with which Judas found fault. From a passage in Horace it appears that this ointment was so valuable among the Romans, that as much as could be contained in a small box of precious stone was considered as a sort of equivalent for a large vessel of wine, and a proper quota for a guest to contribute at an entertainment, according to an ancient custom.

PALMÆ, or PALMS.—Under this name Linnæus has arranged several genera, which, although capable of a place in separate classes of his system, he chooses rather, on account of their singular structure, to place apart in an appendix to the work. The plants of this nature constitute one of the seven families or tribes, into which all vegetables are distributed by Linnæus in his Philosophia Botannica. They are defined to be plants with simple stems, which at their summits bear leaves resembling those of the ferns, being a composition of a leaf and a branch; and whose flowers and fruit are produced on that particular receptacle or seat called a spadix, protruded from a common calyx, in form of a sheath or scabbard, termed by Linnæus spatha. That species which is called *Phœnix*, the *great palm* or *date tree*, has its calyx, three-parted; corolla three-petaled: male, stamina three; female, pistil one; drupe ovate. The *phœnix dactylifera*. or *common date tree*, is a native of Africa and the eastern countries, where it grows to fifty, sixty, and a hundred feet high. The trunk is round, upright, and studded with protuberances, which are the vestiges of the decayed leaves. From the top issues forth a cluster of leaves or branches, eight or nine feet long, extending all round like an umbrella, and bending a little towards the earth. The bottom part produces a number of stalks, like those of the middle; but seldom shooting so high as four or five feet. These stalks, says Adanson, diffuse the tree very considerably, so that, wherever it naturally grows in forests, it is extremely difficult to open a passage through its prickly leaves. The fruit is somewhat in the shape of an acorn, but larger. It is composed of a thin, light, and glossy membrane; somewhat pellucid and yellowish, which contains a fine, soft, and pulpy fruit, which is firm, sweet, and somewhat vinous to the taste; esculent, and wholesome: within this is enclosed a solid, tough, and hard kernel, of a pale grey colour on the outside, and finely marbled within, like the nutmeg. For medicinal use dates are to be chosen, large, full, fresh, yellow on the surface, soft, and tender, not too much wrinkled; such as have a vinous taste, and do not rattle when shaken. They are produced in many parts of Europe, but never perfectly ripen there. The best are brought from Tunis; they are also very fine and good in Egypt, and many parts of the east. The preserved dates are a most delicate sweetmeat, imported into this country from abroad, and are sold by our grocers. It may not be improper to mention, that the palm has, among almost all nations, been regarded as an emblem of victory, and assigned as the reward of it. The reason why this tree was adopted, and made use of to represent victory, is said to be, because it is so elastic, that if pressed by the greatest weight, it will rise superior to the pressure, and be able to restore itself to its former state, appearing almost invincible.

PAPAVER, or the POPPY, of which there are nine species, the principal of which are, 1. *Papaver Rhœas*, the *Corn-rose*, *Cop-rose*, or *Headwark*, which grows in corn-fields, and flowers from June till August. The petals, when infused, yield a fine colour; and a syrup is prepared from such infusion, which partakes in some measure of the properties of opium, and is occasionally used in coughs and catarrhal affections, on account of its anodyne effects. These flower-leaves also yield, on expression, a bright red juice, which imparts its colour to water, and the tint of which may be greatly improved by the addition of the vitriolic acid. Thus cloth, linen, and especially silk and cotton, are dyed of a beautiful deep red shade. The stuffs, previously immersed in a solution of bismuth, acquire a yellow cast, though Dambourney obtained only a pale nut colour. 2. *Papaver Album,* or *Somniferum,* the *White* or *Wild Poppy,* is found in neglected gardens and corn-fields, where it flowers in the months of June and July. The juice which, after making incisions, exudes from the heads of this species, is suffered to inspissate by the heat of the sun, and thus affords the drug called opium. An extract is also prepared from these seed vessels; which, being less powerful than the foreign opium, is given in a double quantity to produce similar effects. The seeds are very nourishing; are divested of the narcotic quality of the flower; and yield on expression a mild sweet oil, little inferior to that of almonds: hence they are often employed as an article of diet. Linnæus counted in one poppy-head thirty-two thousand seeds.

Buxus, or the **Box Tree**, of which there is only one species called *Buxus Sempervirens,* or *Evergreen Box;* but there are three varieties of it, viz. 1. *Buxus Arborescens,* or *Common Box Tree;* 2. *Buxus Angustifolia,* or *Narrow-leaved Box Tree;* and 3. *Buxus Suffruticosa,* or *Dwarf Box Tree.* Box is well known in its dwarf state, and as a shrub about three feet in height; it becomes, however, when left to itself, a tree twelve or fifteen feet high, with a trunk equalling the human thigh in thickness, covered with a rugged, greyish bark, that of the branches yellowish. The wood is of a yellow colour, of an even close grain, very hard and ponderous. It is the only one of the European woods which will sink in water. Theophrastus ranks it with the ebony for closeness of grain. The leaves are ovate or oval in the common sort, hard, smooth, glossy, evergreen, very dark green above, pale green underneath, something resembling those of the myrtle, but blunt, and commonly emarginate at the end; the edges are revolute, they are set on very short petioles, and on the twigs they come out regularly in pairs, so close as almost to conceal them. On these, from the axils of the leaves, come out the small herbaceous flowers, in round bunches; a female flower, occupying the middle of the bunch, and being surrounded by several males. The female flower is succeeded by a capsule of a globular form, very smooth, shining tricoccous, and before it opens having three beaks, then resembling a tripod; the rind is three-valved, and the valves are two-horned; the cocculi or grains are of the consistency of paper, two-valved, and opening with an elastic spring; receptacle central, three-sided, and short; in each cell is a pair of seeds, ovate, growing more slender upwards, triangular-compressed, obliquely truncate at the end, blackish-brown or black, smooth. The two sorts of box tree have been frequently raised from seeds, and constantly produced plants of the same kind with those the seeds were taken from; and the dwarf box will never rise to any considerable height with any culture, nor have we ever seen this sort flower where the plants have been encouraged to grow many years in the greatest luxuriancy. There are two or three varieties of the first, which are propagated in the gardens, one with yellow, and another with white, striped leaves. The other has the tops of the leaves only marked with yellow, which is called tipped box. The box tree is a native of most parts of Europe, from Britain southwards. There are whole mountains covered with it between Lyons and Geneva, &c. but they are not very large. It is also common in many parts of Burgundy, Dauphiné, and Provence. In many countries of Asia it likewise abounds, as about Mount Caucasus, in Persia, China, Cochin-China, &c. and in America. In England it was formerly much more common than it is at present. 'These trees rise naturally,' says Evelyn, 'in Kent, at Boxley; and in Surrey, giving name to Box Hill. He that in winter should behold some of our highest hills in Surrey clad with whole woods of them, for divers miles in circuit; as in those delicious groves belonging to the late Sir Adam Brown, of Beckworth castle, might easily fancy himself transported into some new or enchanted country.' The enchantment, alas! has been long broken. Mr. Miller, in 1759, lamented, that the trees on Box Hill had been then pretty much destroyed, though many remained of a considerable size; and the destruction since that time has been much greater. It has been conjectured that Box Hill was planted with these trees by the Earl of Arundel; but there is the most authentic proof that they were there before his time, and the ground on which they grow was not his property. Not only this hill near Darking in Surrey, and Boxley in Kent, but Boxwel in Cotteswold, Gloucestershire, was named from this tree. Mr. Woodward remarks it as plentiful on the chalk-hills near Dunstable. It is fond of open, dry situations, and a calcareous soil. In temperate climates and seasons it flowers in February and March. The wood of the box tree sells at a high price by weight; for being very hard and smooth, and not apt to warp, it is well adapted to a variety of nicer works. 'It is of special use,' says Evelyn, 'for the turner, engraver, carver, mathematical instrument maker, comb and pipe, or flute maker; the roots, for the inlayer and cabinet maker. Of box are made wheels and shivers, pins, pegs for musical instruments, nut-crackers, button-moulds, weavers' shuttles, hollar sticks, bump sticks, and dressers for the shoemakers, rulers, rolling pins, pestles, mall balls, beetles, tops, tables, chessmen, screws, bobbins for bonelace, spoons, knife-handles, nay the stoutest axletrees, but especially combs.' The English wood is esteemed inferior to that which comes from the Levant; and the American box is said to be preferable to ours. All the varieties of box may be propagated by cuttings planted in autumn in a shady border, observing to keep them watered until they have taken root, when they may be transplanted into the nursery, until they are fit for the purpose intended. These cuttings may be planted so early as August, but the best time is when the autumnal rains fall. The manner of planting it in edges is well understood by every working gardener.

MUSA, or the PLANTAIN TREE. That species called the *Musa Paradisiaca*, is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread; and some of the white people also prefer it to most other things, especially to the yams and cassada bread. The plant rises with a soft stalk fifteen or twenty feet high; the lower part of the stalk is often as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side; these are often eight feet long, and from two to three broad, with a strong fleshy midrib, and a great number of transverse veins running from the midrib to the borders. The leaves are thin and tender, so that where they are exposed to the open air, they are generally torn by the wind; for, as they are large, the wind has great power against them: these leaves come out from the centre of the stalk, and are rolled up at their first appearance; but when they are advanced above the stalk, they expand and turn backward. As these leaves come up rolled in this manner, their advance upward is so quick, that their growth may be almost discovered by the naked eye; and if a fine line be drawn across level with the top of the leaf, in an hour the leaf will be near an inch above it. When the plant is grown to its full height, the spikes of flowers appear in the centre, which is often near four feet long, and nods on one side. The fruit or plantain is about a foot long, and an inch and a half or two inches diameter: it is at first green, but when ripe pale yellow. The skin is tough; and within is a soft pulp of a luscious sweet flavour. The spikes of the fruit are often so large as to weigh upwards of forty pounds. The fruit of this sort is generally cut before it is ripe. The green skin is pulled off, and the heart is roasted in a clear fire for a few minutes, and frequently turned: it is then scraped, and served up as bread. Boiled plantains are not so palatable. This tree is planted on a very extensive scale in Jamaica; without the fruit of which, Dr. Wright says, the island would scarcely be habitable, as no species of provision could supply their place. Even flour or bread itself would be less agreeable, and less able to support the laborious negro, so as to enable him to do his business, or to keep in health. Plantains also fatten horses, cattle, swine, dogs, fowls, and other domestic animals. The leaves being smooth and soft are employed as dressings after blisters. The water from the soft trunk is astringent, and employed by some to check diarrhœas, Every other part of the tree is useful in different parts of rural economy. The leaves are used for napkins and table cloths, and are food for hogs.—The *Musa Sapientium*, or the *Banana Tree*, differs from the preceding in having its stalks marked with dark purple stripes and spots. The fruit is shorter, straighter, and rounder: the pulp is softer, and of a more luscious taste. It is never eaten green; but when ripe, it is very agreeable, either eaten raw, or fried in slices as fritters, being relished by all ranks of people in the West Indies. Both the above plants were carried to the West Indies from the Canary Islands; whither, it is believed, they had been brought from Guinea, where they grow naturally. They are also cultivated in Egypt, and in most other hot countries, where they grow to perfection in about ten months from their first planting to the ripening of their fruit.

CALENDULA OFFICINALIS, or GARDEN MARIGOLD, hath its seeds all boat-form, muricated, and bent in. It is a native of France, in the vineyards; of Italy, in the corn-fields; of Silesia, in orchards, gardens, and fields; flowering most part of the summer. Parkinson informs us, that he received the seed of the single marigold from Spain, where it grows wild: it was, however, cultivated by Gerard in 1597, and probably much earlier. The golden splendour of the flowers, says John Bauhin, ennobled this plant, before it was known to be of any use. It has been cultivated in this country time out of mind in kitchen gardens for the flowers, which were dried in order to be boiled in broth: from a fancy that they are comforters of the heart and spirits. Linnæus accordingly says, that they may be used in a double dose as a succedaneum to saffron; but modern practice has little confidence in these supposed cordials. The common, or officinal marigold is a plant which is now much out of use in the materia medica. It has been considered as useful in the scrophula of children, eaten in the manner of sallad. There is a certain acrimony in the plant, insomuch that it has been commended as an extirpator of warts. It has been asserted, that a marigold flower strongly rubbed on the affected part, is an admirable remedy for the pain and swelling occasioned by the sting of a wasp or bee. According to the observation of Linnæus, the flowers are open from nine in the morning till three in the afternoon. This regular expansion and closing of the flowers attracted early notice, and hence this plant acquired the name of solsequia or solis sponsa. There is an allusion to this property in the poems ascribed to Rowley:

'The mary-budde that shootethe (shutteth) with the lighte.'

But more fully thus by Shakspeare:

'The marigold, that goes to bed wi' th' sun
And with him rises weeping.'

Of the garden marigold there are the following varieties: 1. The single. 2. The common double-flowering. 3. The largest very double-flowering. 4. The double lemon-coloured. 5. The greater and smaller

INDEX

TO

VOLUME THE SECOND.

ACACIA, description of, 446.
Acer, or Maple Tree, described, 446.
Achillea, or Milfoil, description of, 447.
Acorus, or Sweet Rush, described, ib.
Adiantum, or Maidenhair, described, ib.
Æsculus Hippocastanum, or Common Horse Chesnut, ib.
Agaricus Campestris, or Common Mushroom, or Champignon, ib.
Akouchi, or Olive Cavy, common in Guiana and other parts of South America, 89.
Albatross, the first of the Gull kind, description of, 267.
Alco, of America, description of the, 87.
Alonate. See Ouarine.
Althæa Officinalis, or Marsh Mallow, 448.
America, the Condor of. See Condor.
Anacardium, or Cashew Nut, or Acajou, 448.
Anagallis Arvensis, or Pimpernel, 448.
Angelica, 448.
Animal, (Anonymous) described, 92.
Ant, description of, 428.
Apes, Nomenclature of, 36. Ape, an animal without a tail, whose face is flat, whose teeth, hands, fingers, and nails, resemble those of man, and who, like him, walks erect on two feet, ib. The Pithecos of the Greeks, and the Simia of the Latins, a true ape, 37. An ape as tall and strong as man, found in Africa and India, ib. This species of ape called Orang-outang, ib. Gibbon walks on end, and has a flat face, ib. The ape, by its figure, might be regarded as a variety of the human species, 43. The ape, notwithstanding his resemblance to man, is a brute, 44. In relative qualities the ape farther removed from man than most other animals, 45. Long-armed Ape. See Gibbon. Barbary Ape. See Magot. Apes supposed to be masters of the forests, for neither the tiger or the lion dispute their dominion, 64.
Aquilegia Vulgaric, or Common Columbine, 448.
Arabis, or Wall Cress, 449.
Arbutus, or Strawberry tree, ib.
Argemone, or Prickly Poppy, ib.
Artemisia, or Southernwood, 430.
Artacarpus, or Bread-fruit Tree, ib.
Asparagus, or Sperage, ib.
Atriplex Hortensis, or Garden Orach, ib.
Atropa Mandragora, or Mandrake, 451.
Auk, Puffin, and other birds of the penguin kind, description of, 274.
Avena, or Oat, 451.
Avosetta, chiefly found in Italy, but now and then comes to England, description of, 259.
Baboon, a different animal from the ape, 37. Three species of, different from one another, ib. Barbary Ape, an intermediate species between the ape and baboon, ib. Baboon, properly so called, description of, 56. Passionately fond of raisins, apples, and all fruits which grow in gardens, 57. Distinctive characters of this species, ib. Great Baboon, description of, 58. Generally five feet high, and of tremendous strength in all its parts, ib. The Mandrill, or Ribbed-nose Baboon, description of, 58. Found on the Gold Coast and other southern provinces of Africa, 59. Next to the Orang-outang, the largest of all the apes or baboons, ib. Distinctive characters of this species, ib. The Ouanderou, and the Lowando, description of, ib. Baboon-ouanderous, when not tamed, so mischievous that they must be kept in iron cages, 60. Distinctive characters of this species, ib. The Maimon, or Pig-tailed Baboon, description of, ib. Distinctive characters of this species, 61.
Baikal Hare. See Tolai.
Balearic and other foreign Cranes, description of, 253.
Barbary Ape. See Baboon.
Barberry. See Berberis.
Barley. See Hordeum.
Bartsia Viscosa, or Yellow Marsh Eyebright, 451.
Bear, the White, or Polar, a famous animal in our most northern regions, 78. The bear of the northern seas feeds upon fishes, 79. Never quits the margins of the sea, and often inhabits the floating islands of ice, ib. Incapable of swimming long, and never accomplishes above a league at a time, ib. Seals are the common prey of white bears, ib. Their skins sometimes thirteen feet long, 80.
Bee, description of the, 417.
Beet, 452.
Beetle and its varieties, description of, 430.
Bell Flower. See Campanula.
Bellis, or the Daisy, 451.
Berberis, or Barberry, 451.
Betony, or Wood Betony, 452.
Betula, or Birch Tree, 452.
Birds in general, dissertation on, 186. Introductory remarks, ib. Seem formed entirely for escape, ib. Compared with man, birds seem more rudely and imperfectly formed, ib. Seem chiefly formed to inhabit the regions of air, ib. The external parts of birds adapted for swiftness and motion, ib. Feathers with which birds are covered an object of admiration, 187. Wings, instruments by which flying is performed, ib. In all birds, except nocturnal ones, the head smaller in proportion, 188. The sense of seeing in birds superior to that of other animals, ib. All birds want the external ear standing out from the head, ib. Sense of smelling vivid in the generality of birds, ib. Internal conformation of birds fits them for a life in air, ib. Granivorous birds differently formed from those of the rapacious kind, 189. Subject to few diseases, ib. Moulting season, ib. Birds begin to pair at the approach of Spring, 190. Nothing exceeds the patience of birds while hatching, ib. Old birds provide their young, till fledged, with a regular supply, 191. Seldom scared from their usual haunts, ib. Few water-fowl breed in our climate, 192. Migration of birds, ib. Birds a more long-lived class of animals than quadrupeds or insects of the same climate, 192. Birds fitted for sporting in air, 193. Not difficult to distinguish land from water fowl by the legs and toes, ib. Linnæus divides all birds into six classes, ib. Of rapacious birds in general, 199. Birds of the poultry

kind in general, described, 213. Almost, if not all the domestic birds of the poultry kind maintained in our yards, of foreign extraction, ib. Description of birds of the pie kind in general, 224.
Bittern, or Mire-drum, description of the, 256.
Blackcap, diminutive, yet prized for its singing, 244.
Black Cock. See Grous.
Boar of Ethiopia or Cape Verd, description of the, 83.
Botany, concise view of, 445.
Box Tree. See Buxus.
Brasilian Hare. See Tapeti.
Bread-fruit Tree. See Artacarpus.
Bubon, or Macedonian Parsley, 453.
Bug and its varieties, description of, 388.
Bustard, description of, 220. The largest land bird that is a native of Britain, ib. Much larger than the turkey, 221. Assemble in flocks in October, and keep together till April, ib.
Butcher Bird, description of the, 210. Three or four kinds of butcher-birds, ib.
Butterflies and Moths, description of, 411.
Buxus, or the Box Tree, 457.
Cachalot and its varieties described, 295.
Calendula Officinalis, or Garden Marigold, 458.
Calf, (Sea.) See Seal.
Callitriche Verna, or Vernal Starwort, or Star-headed Water Chickweed, 459.
Callitrix, or Green Monkey, with a black and flattish face, 65. Found in Senegal, as well as Mauritania, and the Cape de Verd Islands, 66. Distinctive characters of this species, ib.
Campanula, or the Bell Flower, 461.
Canadian Otter. See Otter.
Canary-bird and other hard-billed singing-birds, description of, 245.
Canella, or White Cinnamon Tree, 461.
Capuchin Monkey. See Sajou.
Carrion-crow. See Raven.
Casan Marmot. See Souslik.
Cashew Nut. See Anacardium.
Cassowary, a bird first brought to Europe by the Dutch, from Java, where it is only to be found, 197. This animal mostly distinguished by its head, which is small, 198. The internal parts remarkable, ib.
Caterpillars in general, description of, 405. Transformation of the Caterpillar into a Butterfly or Moth, 406. Of the enemies of, 413.
Caverns, addition to the article concerning, 143. Of Caverns formed by the primitive Fire, 143.
Cavy, description of the Rock, 90.
Cavy (Olive). See Akouchi.
Chamelion, Iguana, and Lizards of different kinds, description of, 361. See Lizards.
Champignon. See Agaricus Campestris.
Children to teach, and men to address, very different offices, 36. Children receive without examination, the arbitrary and the real, the true and the false, when presented to them as precepts, ib.
Chinese Bonnet. See Malbrouck.
Cicada, description of, 397.
Cinnamon Tree, (White). See Canella.
Coaita, and Exquima, description of, 71. Distinctive characters of these species, 72. The Sapajous are very dexterous and intelligent, ib.
Cock, description of the, 214. Seems to have been the oldest companion of mankind, ib. Not known when the cock was first made domestic in Europe, 215. No animal in the world has greater courage than the cock when opposed to one of his own species, ib. Cock of the Wood. See Grous.
Coffea, or the Coffee Tree, 452.
Columbine (Common.) See Aquilegia Vulgaris.
Condor of America, description of, 203. Possesses all the qualities that render it formidable, ib.
Coot. See Water-hen.
Corbira. See Avosetta.
Cormorant, description of, 268.
Cow of Tartary, description of the, 80.
Crab-eater, description of the, 91. Crab-dog, a name also given to this animal, ib. Legs very short, ib. Climbs trees with great dexterity, ib.
Crane kind, description of birds of the, 249. Crane, description of, 250. A wandering, social bird, 251. See Stork. Balcaric. Crane kind, small birds of the, with the thighs partly bare of feathers, description of, 260.
Cress (Wall.) See Arabis.
Cricket, description of, 397. Mole Cricket described, ib.
Crocodile and its affinities, description of, 354.
Crow. See Raven.
Cuckoo and its varieties, description of, 233. The cuckoo has given rise to many fables, ib. His note pleasant though uniform, ib. Many kinds in various parts of the world, 234.
Cudweed. See Gnaphalium.
Daisy. See Bellis.
Dodo, description of the, 199. The bill of an extraordinary length, ib. A native of the Isle of France, ib.
Dolphin, Grampus, and Porpesse, with their varieties, description of, 296.
Douc, or Cochin China Monkey, description of, 67. Called Sifac in Madagascar, ib. The douc and all the monkeys belong to the Old Continent, 68. Distinctive characters of this species, ib. See Monkeys.
Dragon Fly. See Libella.
Duck and its varieties described, 279.
Dugon. See Walrus.
Eagle and its affinities described, 201. The Golden Eagle the largest and noblest of those birds which have received the name of eagle, ib. Its sight and sense of smelling very acute, ib. May be considered among birds as the lion among quadrupeds, ib. Sometimes brought to have an attachment to their feeder, ib. The eagle at all times a formidable neighbour, 202. Remarkable for its longevity, ib. The Golden Eagle, of a tawny iron colour, 203. The Common Eagle, of a brown colour, ib. The Bald Eagle, brown, ib. The White Eagle, all white, ib. The Rough-footed Eagle, of a dirty brown, ib. The White-tailed Eagle of a dirty brown, ib. The Erne, Black Eagle, Sea Eagle, Osprey, Jean le Blanc, Eagle of Brasil, Oronoko Eagle, Crowned African Eagle, Eagle of Pondicherry, ib.
Earth, additions to the Article, of the inequalities of the surface of the, 103. Of the height of mountains, ib. Heights of the most elevated mountains of the province of Quito in Peru, 104. Of the direction of mountains, 105. Of the formation of mountains, 106. Of the density which certain matters acquire by fire, as well as by water, ib. Experiments, 107. Of the inclination of the strata in the mountains, ib. Of the Peaks of Mountains, 108.
Earthquakes and Volcanoes, additions to the article concerning, 124. Of earthquakes, ib. Of volcanoes, 126. Of the changes which have happened in volcanoes, ib. Of extinguished volcanoes, 136. Of lavas and basalts, 140.
Earwig, description of, with the Froth Insect, and others of the second order of insects, 402.
Egret. See Macaque.
Emu, a bird but little known, 197. Chiefly found in Guiana, along the banks of the Oronoko, in Brasil and Chili, and the forests bordering on the mouth of the river Plata, ib.
Ephemera, description of, 403.
Ethiopian or Cape Verd Boar, description of, 83.
Exquima. See Coaita.

Eyebright (Yellow Marsh.) See Bartsia Viscosa.
Fair Monkey. See Mico.
Falcon kind and its affinities, description of, 207. Falconry the principal amusement of our ancestors, now disused among us, ib.
Fishes. In the animal kingdom, where fishes terminate, the terrestrial tribes commence, 25. Dissertation on fishes in general, 283. The ocean the great receptacle of fishes, ib. Of cetaceous fishes in general, 289. Of cartilaginous fishes, 298. Description of anomalous cartilaginous fishes, 307. Spinous fishes described, 310. Prickly-finned fishes, 311. Soft-finned fishes described, 312. Spinous fishes in general described, 313. Crustaceous and testaceous fishes, 321. Of the shell of testaceous fishes, 332. Turbinated shell-fish of the snail kind, 336. Of bivalved shell-fish, or shells of the oyster kind, 340. Of Multivalve shell-fish, 344.
Flamingo, description of, 258.
Flea, description of, 385.
Fly (Water.) See Earwig.
Formica Leo, or Lion-ant, description of, 395.
Fox-tailed Monkey. See Saki.
Frogs and Toads in general, description of, 346. The frog and its varieties, ib. The toad and its varieties, 349.
Froth Insect. See Earwig.
Galera, or Guinea Weasel, description of the, 88.
Gambogia, 461.
Gannet or Soland Goose, description of, 269.
Geography, additions to the article concerning, 94. On the extent of terrestrial continents, ib. Calculation of the Eastern Continents by geometrical leagues square, ib. *n.* Calculation of the Continent of America according to the same measures, ib. *n.* Of the form of continents, 95. Of the Terra Australis, ib. Of the invention of the mariner's compass, 96. Of the discovery of America, ib.
Gibbon, or Long-armed Ape, 54. Keeps himself always erect, even when he walks on four feet, ib. Distinctive characters of this species, 55. See Ape.
Glutton, description of the, 1. Called Carcajou in Canada and other parts of North America, ib. The size of a large dog, has the ears and face of a cat, and a rough tail like the fox, ib. The only animal that can live under the line and under the pole, ib. Watches large animals like a robber on the highway, or surprises them while asleep, 2. M. de Seve's description of a similar animal, 4.
Gnaphalium, Cudweed, Goldylocks, Eternal or Everlasting Flower, 455.
Gnat and Tipula, description of, 435.
Goose kind, properly so called, description of birds of the, 277. Goose and its varieties, description of, 278.
Grampus. See Dolphin.
Grasshopper, description of, 397.
Great-eared Monkey. See Tamarin.
Grous and its affinities, description of the, 221. The Cock of the Wood, the Black Cock, the Grous, and the Ptarmigan, birds of a similar nature, ib. The cock of the wood sometimes the size of a turkey, 222.
Guenons. See Monkeys.
Guinea-hen. See Pintada.
Guinea-hog, description of the, 82.
Gull. See Albatross. The smaller gulls and Petrels described, 270.
Heron and its varieties, description of the, 254.
Hordeum, or Barley, 451.
Horse Chesnut. See Æsculus Hippocastanum.
Humming-bird, and its varieties, description of, 248.
Ichneumon Fly, description of, 427.
Iguana. See Chameleon
Indian Walrus. See Walrus.
Insects in general, dissertation on, 378. Insects without wings described, 381. Of the Spider and its varieties, ib. Of the Flea, 385. Of the Louse and its varieties, ib. Of the Bug and its varieties, 388. Of the Wood-louse and its varieties, 889. Of the Monoculus, or Aborescent Water-flea, ib. Of the Scorpion and its varieties, ib. Of the Scolopendra, and Gally-worm, 392. Of the Leech, ib. Of the second order of insects in general, 394. Of the Libella, or Dragon-fly, ib. Of the Formica Leo, or Lion-ant, 395. Of the Grasshopper, Locust, Cicada, Cricket, and Mole Cricket, 397.
Jonquil. See Narcissus Jonquilla.
Juan Fernandez, Seals visit the Island of, 16.
Kingdom, (Animal), terrestrial tribes commence where that of fishes terminate, 25.
King-fisher, description of, 282.
Lamprey and its affinities, described, 304.
Land, additions to the article concerning the changes of sea into, 150.
Lark, whether the Sky-lark, the Wood, or the Tit-lark, loud in their song, 244. The lark builds its nest upon the ground, ib.
Leech, description of, 392.
Leming, description of the, 11. Olaus Magnus the first who mentions the Leming, ib. Generally inhabit the mountains of Norway and Lapland, ib. Make dreadful devastation in the fields, &c. ib.
Leonine Seal, description of, 18.
Libella, or Dragon-fly, description of, 394.
Lion-ant, description of, 395.
Lion, (Sea.) See Seal.
Lizards in general, description of, 353.
Lobster kind, crustaceous animals of the, described, 321.
Locust, description of, 397.
Long-armed Apes. See Gibbon.
Louse and its varieties, description of, 385.
Lythophytes and Sponges, description of, 443.
Macaque, or Hare-lipped Monkey, and the Egret, description of, 61. Distinctive characters of this species, 62. The egret seems to be a variety of the macaque, ib. See Monkeys.
Madagascar Rat, description of the, 92.
Magellanic Penguin (Great), description of, 272.
Magot, or Barbary Ape, description of, 55. Hath a long face, not unlike that of the dog, ib. This ape, when erect upon his two hind legs, generally two feet and a half, or three feet high, ib. There are some varieties in this species, ib. Distinctive characters of this species, 56. See Baboon.
Magpie and its affinities, description of, 228. A great variety of birds may be distributed under this head, ib. The magpie the chief of this kind with us, ib. The jay referred to this tribe, 229. Of the magpie there are four or five varieties, ib.
Maidenhair. See Adiantum.
Maimon, or Pig-tailed Baboon. See Baboon.
Malbrouck, and Chinese Bonnet, description of, 63. These two monkeys seem to be of the same species, ib. Distinctive characters of these species, 64.
Malbrouck. See Monkeys.
Manati, description of, 24. Of an enormous size, some being twenty-eight feet long, and weighing eight thousand pounds, ib. The skin so hard as scarcely to be cut with an ax, ib. Its flesh and fat said to be analogous to those of veal, 27. Manati of Senegal differs not from that of Cayenne, 28. Dampier's remarks on the Manati, ib. Delights to live in brackish water, ib. See Seal.
Mandrake. See Atropa Mandragora.
Mandrill. See Baboon.
Mangabey, or Monkey with White Eye-lids, description of, 64. Distinctive characters of this species, ib. See Monkeys.
Marigold, (Garden.) See Calendula Officinalis.
Marikina, or Silky Monkey, description of, 77. Commonly

distinguished by the name of the small lion-ape, ib. Distinctive characters of this species, ib.

Marmot, (Earless.) See Zisel.

Marmot, (Lapland.) See Leming.

Marshmallow. See Althæa Officinalis.

Mexican Wolf, description of the, 87.

Mexican Shrew. See Tucan.

Mico, or Fair Monkey, description of the, 78. Distinctive characters of this species, ib.

Milfoil. See Achillea.

Mire-drum. See Bittern.

Mona, or Varied Monkey, the most common of all the monkeys, description of, 65. Distinctive characters of this species, ib.

Monkey. See Macaque.

Monkeys, animals resembling apes and baboons, except their tails, 38. Seven species of monkey, viz. Macaque, Patas, Malbrouck, Mangabey, Moustac, Talapoin, Douc, ib.

Monoculus, or Aborescent Water-flea, description of, 389.

Morse, or See Cow. See Walrus.

Mouffettes. See Polecats.

Moustac. See Monkeys.

Mule, description of the, 28. Limbs of the mule hard and limber, like those of the horse, 29. Experiments on the admixture of animals, ib. Mules will produce foals, 32. Instance of the prolific powers of a she-mule in the north of Scotland, 33. In domestic animals multiplication greater than in those in a wild state, 34. The fecundity of mixed species less than that of the pure, ib.

Musa, or the Plantain Tree, 458.

Mushroom. See Agaricus Campestris.

Mustache, a species of monkey, description of the, 66. Distinctive characters of this species, ib.

Myristica, the Nutmeg Tree, 453.

Myrtus, the Myrtle, 454.

Narcissus Jonquilla, the Jonquil, 455.

Nardus, or Spikenard, 456.

Narwhale, description of, 294.

Nature, facts and arguments in support of the Count de Buffon's Epochs of, 151. States the different epochs of nature, which he divides into seven great periods, 162. Of giants, 166. Of the glaciers, 174. Of the north-east passage, 176. Concerning that period when the powers of man aided those of Nature, 179.

Nightingale and other soft-billed song birds, description of, 243. This most famous of the feathered tribe visits England in the beginning of April, and leaves it in August, ib. Prepares to make its nest in the beginning of May, 244.

Nomenclature of Apes, 36.

Nutmeg Tree. See Myristica.

Opossum, (Merian), description of, 88. The young of these animals grunt nearly in the same manner as the pig, 89.

Orach, (Garden.) See Atriplex Hortensis.

Orang-outangs, or the Pongo and Jocko, the history of those animals, 46. The pongo exactly proportioned like a man, ib. Differ from the human species in the number of ribs, 49. The orang-outang has a greater resemblance to man than to apes or monkeys, 50. See Ape.

Orange Monkey. See Saimiri.

Ostrich, description of, 194. Seems to unite the quadruped and bird in itself, ib. The largest of all birds, ib. Plumage much alike in all, ib. The thighs very fleshy and large, 195. The internal parts formed with surprising peculiarity, ib. Its flesh proscribed in Scripture as unfit to be eaten, ib. The plumage of the ostrich valuable, 196. Modes of taking the ostrich, ib.

Otter, description of the Sea, 12. Length, from nose to tail, four feet two inches, ib. Canadian Otter described, 13. Much larger than ours, ib.

Ouanderou and Lowando. See Baboon.

Ouarine and Alouate, description of, 69. Called the preacher monkey, ib. The largest four-handed animals in the New Continent, ib. Distinctive characters of this species, 71.

Ouistiti, or Striated Monkey, description of the, 76. At first very ugly, having hardly any hair on their bodies, ib. Distinctive characters of this species, ib.

Owl kind that prey by night, rapacious birds of, description of, 211. All birds of the owl kind considered as nocturnal robbers, ib. Distinguished from other birds by having their eyes formed for seeing better in the dark than the light, ib. Though dazzled by too bright a light, do not see best in the darkest nights, ib. Nights when the moon shines the times of their most successful plunder, ib. Some owls have horns, some are without, ib. Barn-owl lives chiefly upon mice, 212. Screech-owl's voice considered as a presage of calamity, ib. Owls shy of man and difficult to be tamed, 213.

Palmæ, or Palms, 456.

Papaver, or the Poppy, 456.

Paradise (Bird of) and its varieties, description of, 232. Few birds puzzled the learned more than this, ib. Its plumage beautiful, ib. There are two kinds of the bird of paradise, ib.

Parakeet. See Parrott.

Parrot and its affinities, description of, 234. The parrot best known among us of all foreign birds, ib. Taught to speak with facility, ib. Small Parakeet tribe, delicate food, 236. Have usually the same disorders as other birds, 237.

Partridge and its varieties, description of, 223. A favourite delicacy at the table of the rich, ib. There are two kinds, the grey and the red, ib. There are several methods of taking them, ib. Can never be thoroughly tamed like other domestic poultry, 224.

Patas, or Red Monkey, description of, 62. Distinctive characters of this species, ib. See Monkeys.

Peacock, description of the, 216. Said to have the plumage of an angel, the voice of a devil, and the guts of a thief, ib. The first peacocks brought from the East Indies, ib. There are varieties of this bird, some white, others crested, 217.

Pekan, and the Vison, description of, 9. Pekan weasel, in form like a martin, but much less, ib. The name pekan long familiar in the fur trade of Canada, ib. Our knowledge of this animal very imperfect, ib. Our knowledge of the vison equally imperfect, ib.

Pelican, description of, 265.

Penguin kind, description of, 272.

Perouasca, description of, 81. Lives in woods, and burrows in the ground, 82. Its skin a beautiful fur, ib.

Petrels. See Gull.

Pheasant, description of the, 219. The most beautiful of birds next to the peacock, ib. Though beautiful to the eye, not less delicate when served up at the table, ib. The spirit of independence seems to attend the pheasant even in captivity, ib. Of the pheasant there are many varieties, 220.

Phillcria, or Mock Privet, 455.

Phoca. See Seal.

Pie kind, description of birds of the, 224. A noisy, restless, chattering tribe, that flutters round our habitations, with the spirit of pilferers rather than of robbers, 225. With respect to man this class rather noxious than beneficial, ib. This class being numerous, their manners are not alike in all, ib.

Pigeon and its varieties, description of, 237. The tame pigeon, and all its beautiful varieties, derive their origin from the stockdove only, ib. Dove-house pigeon breeds every month, ib. Fidelity of the turtle dove proverbial, 238. Varieties of the tame pigeon numerous, ib.

Pigmy, description of the, 52. An ape with a flattish face, and ears like those of a man, ib. The pigmy, Barbary ape, and baboon known to the ancients, 53. Distinctive characters of this species, 54. See Pithecos. Simia.

Pimpernel. See Anagallis Arvensis.

Pinche, or Red-tailed Monkey, description of the, 77. Distinctive characters of this species, ib.

Pintada, description of the, 220. In some measure unites the characteristics of the pheasant and the turkey, ib. In many parts of Africa they are seen in vast flocks together, ib. Kept among us rather for shew than use, ib.

Pistachia Terebinthus, or Pistachia Tree, 454.

Pithecos of the Greeks, a true ape, 37.

Planets, addition to the article concerning the formation of the, 92. On the matter of the sun and planets, 92. On the relation between the density of the planets and their celerity, 93. On the relation assigned by Newton between the density of the planets and the degrees of heat to which they are exposed, ib.

Plantago, or Plantain, 455.

Plantain Tree. See Musa.

Podolian Marmot. See Zemni.

Polecats (Stinking,) description of, 6. Called by travellers stinking beasts, devil's children, &c. ib. Sometimes tamed by the English, French, Swedes, and Savages of North America, 7. There are four species of Mouffettes, ib. Has a great resemblance to the Martin, ib.

Polypus, description of, 440.

Pongo and Jocko. See Orang-outang.

Porpesse. See Dolphin.

Pouc, description of, 81. Larger than the domestic rat, ib.

Prickly Poppy. See Argemone.

Privet (Mock.) See Phillyrea.

Ptarmigan. See Grous.

Puffin. See Auk.

Quail, description of the, 224. Not above half the size of a partridge, ib. Known to be a bird of passage, ib. Less prolific than the partridge, ib. Easily caught by a call, ib.

Rains, Marshes, Subterraneous Wood and Water, addition to the article concerning the effect of, 144. Of the sinking and derangement of certain lands, ib. Of turf, 145. Of subterraneous, petrified, and charred wood, 146. Of bones sometimes found in the interior parts of the earth, 149.

Rat, description of the Madagascar, 92. Like squirrels, carries its food to its mouth with the fore paws, ib.

Raven, Carrion-crow, and Rook, description of, 225. Raven found in every region of the world, 226. Has many qualities that render him amusing, ib. An active and greedy plunderer, ib. The rook builds in woods and forests in the neighbourhood of man, 227. Sometimes the rook makes choice of groves in the midst of cities for the place of its retreat and security, ib. Keep together in pairs, ib.

Ray kind, cartilaginous flat-fish of the, 300.

Red-breast, during the spring, haunts the wood, the grove, and the garden, 244.

Red-tailed Monkey. See Pinche.

Rheum, or Turkey Rhubarb, 459.

Rivers, addition to the article concerning, 109. Observations on the theory of running waters, ib. On the saltness of the sea, ib. Of perpendicular cataracts, 110.

Rock Cavy. See Cavy.

Rook. See Raven.

Runner. See Avosetta.

Rush (Sweet.) See Acorus.

Sable Weasel, description of, 9. About eighteen inches long from nose to tail, ib. Inhabits the banks of rivers, and the thickest parts of the woods, 10. Leap with great agility from tree to tree, ib. The sable differs from all other furs in this circumstance, that the hair turns to any side with equal ease, ib. Supposed to be the Satherius of Aristotle, ib. Live in holes of corrupted trees, or under their roots, ib.

Sagoins. See Sapajous.

Say, or Weeper, description of the, 74. Distinctive characters of this species, ib.

Saimiri, or Orange Monkey, description of, 74. Common in Guiana, ib. Distinctive characters of this species, 75.

Sajou, or Capuchin Monkey, description of, 73. Distinctive characters of this species, ib.

Saki, or Fox-tailed Monkey, description of the, 75. Distinctive characters of this species, ib. Walks on four feet, and is nearly a foot and a half in length, ib.

Salamander, description of, 359.

Sapajous, and the Sagoins, description of, 68. Found in the New World only, ib. There are eight species of sapajous, which may be reduced to five, 69. There are six species of the sagoins, ib.

Saricovienne. See Otter.

Scolopendra and Gally-worm, description of, 392.

Scorpion and its varieties, description of, 389. · Water Scorpion. See Earwig.

Scrooper. See Avosetta.

Sea, addition to the article concerning shells, and other productions of, found in the interior parts of the earth, 100. Of fossil and petrified shells, ib. Of the places where shells are found, 101. Of those great volutes called Cornua Ammonis, and of some large bones of terrestrial animals, 103. Of inequalities at the bottom of the sea, and of currents, 116. Of the nature and quality of the soil at the bottom of the sea, ib. Of currents in the ocean, 117.

Sea God. See Seal.

Seals, the Walrus, and the Manati, description of, 14. Seals comprehend, the Phoca, the Common Seal, or Sea-calf, the Great Seal, and the very large Seal, or Sea-lion, &c. ib. Seals, like man, have a round head, 14. Served as a model for Tritons, Sirens, and Sea Gods, with a human head, the body of a quadruped, and the tail of a fish, ib. Is susceptible of a species of education, ib. A kind of crippled animal, 15. Sea-wolves on the coast of Canada as large as big dogs, ib. Seals live in society, ib. Sea-calves frequent in the north of Europe and America, &c. ib. Juan Fernandes visited by seals, 16. Seals vary in size, colour, and figure in different climates, ib. Three distinct species of the seal, 17. Leonine seal described, 18.

Seas and lakes, additions and corrections to the article concerning, 110. Of the limits of the South Sea, ib. Of double currents in some parts of the ocean, ib. Of the northern parts of the Atlantic Ocean, 112. Of the Caspian Sea, 115. Of the Salt Lakes of Asia, 116.

Serpents in general, description of, 363. Venomous serpents in general described, 370. Serpents without venom described, 373.

Shark kind, cartilaginous fishes of the, 299.

Shell-fish, on the division of, 321.

Shoveler. See Spoonbill.

Shrew (Mexican.) See Tucan. Brasilian Shrew, description of the, 89.

Siberian, or Gilded Mole, description of the, 82.

Silkworm, description of, 414.

Silky Monkey. See Marikina.

Simia of the Latins, a true ape, 37.

Sirens. See Seal.

Soland Goose. See Gannet.

Soul has a proper action independent of matter, 43.

Souslik, description of the, 82. Furnishes a beautiful fur, ib. Distinguished from the mouse or rat by its fur, ib.

Southernwood. See Artimisia.

Sparrow kind in general, description of birds of the, 239. Birds composing this class live chiefly in the neighbourhood of man, and are his greatest favourites, ib.

Spider and its varieties described, 381.

Spikenard. See Nardus.

Sponges. See Lythophytes.

Spoonbill, or Shoveler, description of the, 257.

Star-fish, description of, 440.

Starwort, (Vernal,) or Star-headed Water Chickweed. See Callitriche Verna.
Stork, description of the, 252.
Strata, additions to the article, of the production of, 97. Concerning the strata in different parts of the earth, ib. On the interior rock of the globe, 99. Of the vitrifaction of calcareous substances, 99.
Strawberry Tree. See Arbutus.
Striated Monkey. See Ouistiti.
Sturgeon and its varieties, described, 305.
Sun, on the distance of the earth from the, 92. On the matter of the sun and planets, ib.
Swallow and its affinities, description of, 247.
Swan, Tame and Wild, description of, 277.
Talapoin, a species of monkey, about one foot in length, description of the, 67.
Talapoin. See Monkeys.
Tamarin, or Great-eared Monkey, description of the, 75. There are very small monkeys in Cayenne, which are called Tamarins and are very beautiful, ib. They are very familiar and playful, 76. Distinctive characters of this species, ib.
Tapeti, or Brasilian Hare, description of the, 90. Resembles the European rabbit in figure, ib.
Tartary, the Cow of. See Cow.
Tayra, Galera, or Guinea Weasel, description of the, 88.
Sifac. See Douc.
Tipula (Water.) See Earwig. Gnat.
Toads. See Frogs.
Tolai, or Baikal Hare, has a tail somewhat longer than that of a rabbit, 80. Very common in the neighbourhood of Lake Baikal in Tartary, 81.
Tortoise and its kinds described, 326.
Tritons. See Seal.
Tucan, or Mexican Shrew, description of the, 89.
Turkey, description of the, 217. When once grown up, turkeys are hardy birds, 219. Those of Norfolk said to be the largest of this kingdom, ib.
Vulture and its affinities, description of, 205. Golden Vulture described, ib.
Walrus, Morse, or Sea Cow, description of, 20. Has no resemblance to a cow, ib. Description of the method of taking the Walrus, 21. The Sea Horse (Walrus) resembles the Sea Calf (Seal,) 22. Indian Walrus, or Dugon, described, 23. An animal of the African and East Indian seas, ib. See Seal.
Wasp, description of, 424.
Water-Rat, description of the White, 82.
Water-hen, description of, 263.
Water-fowl in general, description of, 264.
Weasel (Guinea.) See Tayra.
Weasel. See Pekan. Sable.
Weeper. See Sai.
Whale, properly so called, and its varieties, 290.
Winds, additions to the article on regular, 119. Of reflected Wind, ib. Of the state of the air at the top of high mountains, ib. Of some winds that have a regular variation, 120. Of Lavanges, or great masses of snow and ice rolling down from high mountains, 121. Additions to the article of irregular winds, water-spouts, &c. 122. Of the violence of the south winds in some northern countries, ib. Of water-spouts ib.
Wood-louse and its varieties, description of, 389.
Woodpecker and its affinities, description of, 230. Makes holes in trees to procure food, 231.
Worms, description of, 438.
Wren, a diminutive bird, yet prized for its singing, 244.
Zemni, or Podolian Marmot, description of the, 81.
Zisel, or Earless Marmot, without external ears, 81. Of an uniform cinereous gray colour, ib.
Zoophytes in general, description of, 437.

DIRECTIONS TO THE BINDER FOR PLACING THE ENGRAVINGS.

VOL. II.

Plate.		Page.
	Count de Buffon, to face the title.	
1.	Glutton, Serval, Wolf, Spotted Cavy, Margay, Panther,	1
25.	Ootol, Coassc, Jackal, Adive, Kincajou, Female Glutton, Carcajou, Conepate, Patis,	4
28.	Vison, Pecan, Zorille, Young Manati, Walrus, Small Seal, Seal, Canadian Otter,	9
40.	Monkeys, Chinese Bonnet, Malbrouck, Oistiti or Striated Monkey, Mico or Fair Monkey, Marikini or Silky Monkey, Pinche or Red Monkey, White Collared Mangabey, Mangabey,	98
31.	Ouanderou, Callitrix, Maimon, Mona, Talapoin, Mustax, Female Mandrill, Mandrill,	61
5.	Black and Yellow Creeper, Brown and White Creeper, Cayenne Creeper, Dodo, Purre or Stint,	199
24.	Guffard Eagle and the Boatman,	201
37.	Eagle, Vulture, Honey Buzzard, Falcon, Kite, Barn Owl, Horned Owl, Lori of South Sea Island, Lorit, Green Parrot,	201
48.	Crown Bird, Chinese Drake, Peronoptere, Ostrich, Eagle of Monte Video, Eagle of Astracan, Gypacte of the Alps, Gypacte of Africa,	203
39.	Peacock, Bustard, Silver Bustard, Golden Pheasant, Wood Pecker, Tropic Birds and Nest, Bulfinch, Goldfinch, Linnet, Red Pole, Crested Wren, Wren, Cuckoo,	216
52.	Turkey Partridges Male and Female, Quails, Ruff, Lapwing, Cock, Cock of the Wood, Black Cock,	232
41.	King Bird of Paradise, Bird of Paradise, Black Hocco, Humming Birds, Wild Cock and Hen, Crowned Pigeon of Bandy, Whiskered Jack Daw,	232
26.	Spotted Guinea Pigeon, Marginated Long-tailed Dove,	237
16.	Numidian Crane, Crowned or Balearic Crane,	249
45.	Flamingo, Brown Heron, Demoiselle, Spoon Bill, Widgeons Male and Female, Teal Male and Female, Pelican, Albatross, Barnacle, Swan,	258
32.	Genet, French Genet, Virginian Opossum, Flying Squirrel, Murine Opossum, Female Murine Opossum, Maucauco, Clunch,	269
10.	Sacred Kingfisher, African Creeper, Red Spotted Indian Creeper, Eider Duck Male and Female, Garganey Male,	282
47.	Whale, Narwhale or Sea Unicorn, Spermaceti Whale,	290
49.	Barbel, Whiting, Sturgeon, Roach, Ray Fish, Flounder, Sea Devil,	305
35.	Herring, Dolphin, Flying Fish, Balance Fish, Cod, Shark, Carp, Lamprey, Salmon, Perch, Mullet, Eel, John Dorce, Turtle, Crab, Lobster,	316
14.	Safeguard Lizard of Surinam,	353
42.	Summer Loving Viper, Painted Viper, Pethola Viper,	369
51.	Flies, Gnats, Bees, Wasps, Locust, Grasshopper, Butterflies,	435
43.	Coffee Tree, Cashew Nut Tree,	452
46.	Choice Gnaphalium, Mandrake, and Bread Fruit Tree,	455
44.	Palm Tree, Jamaica Plantain, Banana Plantain,	456
50.	Mimosa Cinerea, Turkey Rhubarb, Jamaica Pepper Tree,	459